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A MONOGRAPH OF THE EXISTING CRINOIDS

BY

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VOLUME 1

THE COMATULIDS

PART 3. SUPERFAMILY COMASTERIDA

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PREFACE

Parts 3, 4, and 5 of Volume 1, Bulletin 82, include the systematic discussion of the species and higher groups of living comatulids or unstalked crinoids. Part 3, the present part, includes the account of the superfamily Comasterida, which covers the single family Comasteridae.

In the preparation of the present part I have been under special obligations to Dr. Th. Mortensen, of the Zoological Museum, Copenhagen, who has sent me for examination the magnificent collections which he made in the Kei and Philippine Islands and elsewhere; to Dr. C. C. A. Monro, of the British Museum, who has sent me all of the comatulids which have been received at the British Museum since my last visit to that institution in 1910; to Dr. Torsten Gislén, of Uppsala, Sweden, who sent me a series of specimens from the Bonin Islands; and to Mr. Edward J. Holmes, of Boston.

A complete index to all five parts of Volume 1 will be found at the end of Part 5.

TABLE OF CONTENTS

Page
Preface — iii
Introduction — 1
Preservation of specimens — 65
Identification of Comatulids — 66
Treatment of the species — 66
Order Comatulida — 68
  Suborder Oligophreata — 74
    Superfamily Comasterida — 76
      Family Comasteridae — 76
        Subfamily Capillasterinae — 85
          Genus Comatella — 89
            Comatella nigra — 92
            Comatella stelligera — 98
            Comatella maculata — 112
            Comatella decora — 119
            Comatella brachycirra — 121
          Genus Neocomatella — 122
            Neocomatella pulchella — 124
            Neocomatella alata — 142
            Neocomatella europaea — 150
          Genus Palaeocomatella — 153
            Palaeocomatella difficilis — 154
          Genus Capillaster — 156
            Capillaster macrobrachius — 158
            Capillaster asterias — 160
            Capillaster sentosa — 160
            Capillaster gracilicirra — 169
            Capillaster mariae — 170
            Capillaster multiradiata — 173
            Capillaster tenuicirra — 209
            Capillaster coccodistoma — 212
          Genus Nemaster — 214
            Nemaster grandis — 216
            Nemaster iowensis — 218
            Nemaster rubiginosa — 225
            Nemaster discoidea — 232
          Genus Comanthoides — 240
            Comanthoides spanoschistum — 241
          Genus Comissia — 244
            Comissia magnifica — 247
            Comissia peregrina — 248
            Comissia lütkeni — 249
            Comissia horridus — 254
            Comissia pectinifer — 255
            Comissia littoralis — 256
            Comissia chadwicki — 257
            Comissia hispida — 258
            Comissia spinosissima — 259

Order Comatulida—Continued.
Suborder Oligophreata—Continued.
Superfamily Comasterida—Continued.
Family Comasteridae—Continued.
Subfamily Capillasterinae—Continued.
Genus Comissia—Continued.

Page
Comissia parvula 262
Comissia gracilipes 265
Comissia hartmeyeri 267
Comissia ignota 269
Comissia minuta 270
Comissia scitulus 274
Genus Leptonemaster 275
Leptonemaster venustus 276
Genus Comatilia 284
Comatilia iridometriformis 285
Genus Microcomatula 287
Microcomatula mortenseni 287
Genus Comatonia 288
Comatonia cristata 289
Subfamily Comactiniinae 293
Genus Comatulella 295
Comatulella brachiolata 296
Genus Comatula 302
Subgenus Validia 308
Comatula rotalaria 309
Subgenus Comatula 320
Comatula cratera 320
Comatula solaris 323
Comatula pectinata 339
Comatula purpurea 360
Comatula tenuicirra 372
Comatula micraster 373
Genus Comactinia 374
Comactinia echinoptera 375
Genus Comatulides 400
Comatulides decameros 401
Comatulides australis 403
Subfamily Comasterinae 404
Genus Comaster 409
Comaster multifida 413
Comaster gracilis 430
Comaster minima 435
Comaster multibrachiata 437
Comaster fruticosus 440
Comaster sibogae 442
Comaster schönovi 443
Comaster pulcher 443
Comaster brevicirra 444
Comaster distincta 448
Comaster serrata 451
Comaster tenella 455
Comaster, sp 456
Comaster, sp 456
Comaster, sp 456

Order Comatulida—Continued.
  Suborder Oligophreata—Continued.
    Superfamily Comasterida—Continued.
      Family Comasteridae—Continued.
        Subfamily Comasterinal—Continued.

Page
Genus Comanthina ---- 457
Comanthina belli ---- 458
Comanthina schlegelii ---- 466
Genus Comantheria ---- 483
Comantheria polycnemis ---- 485
Comantheria alternans ---- 488
Comantheria briareus ---- 492
Comantheria rotula ---- 503
Comantheria weberi ---- 505
Comantheria perplexum ---- 506
Comantheria intermedia ---- 508
Comantheria taviana ---- 510
Comantheria grandicalyx ---- 513
Comantheria imbricata ---- 515
Comantheria delicata ---- 521
Genus Comanthus ---- 527
Subgenus Cenolia ---- 530
Comanthus bennetti ---- 531
Comanthus plectrophorum ---- 550
Comanthus pinguis ---- 553
Comanthus japonica ---- 564
Comanthus solaster ---- 576
Comanthus trichoptera ---- 579
Comanthus tasmaniae ---- 586
Comanthus benhami ---- 587
Comanthus novaezealandiae ---- 588
Comanthus wahlbergii ---- 588
Comanthus samoana ---- 593
Subgenus Comanthus ---- 603
Comanthus timorensis ---- 603
Comanthus parvicirra ---- 631
Doubful and indeterminable species ---- 684
Unidentifiable species ---- 691
Explanation of plates ---- 695
Index ---- 779

A MONOGRAPH OF THE EXISTING CRINOIDS

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INTRODUCTION

In the introduction to Part 1 of Volume 1 (pp. 21–55) the evolution of the study of the systematic interrelationships of the comatulids was traced in detail up to the year 1910, but the history of the development of the scheme of classification now in use from its first inception in 1907 was reserved until the present time.

The development of the knowledge of the interrelationships of the comatulids up to 1907 may be briefly recapitulated as follows.

Llhuyd pointed out in 1699 and in 1703 that the rosy feather-star (*Antedon bifida*) is the sea star to which the fossil crinoids are most closely related. In 1733 Linck separated the comatulids from the starfish and serpent stars and distributed the six species known to him among three genera based upon the number of arms. But in 1758 Linné again placed the comatulids with the starfish and ophiurans in the genus *Asterias*.

In order to emphasize its distinctness from the ophiurans with which it was presumably then associated in the minds of naturalists, de Fréminville in 1811 created the genus *Antedon* to receive the common comatulid of the European coasts. In 1815 Leach suggested the genus *Alecto*, including the three species of comatulids with which he was acquainted, and in 1816 Lamarck proposed the genus *Comatula*, in which he placed all the comatulids known to him.

Agassiz in 1836 published the genus *Comaster*, based upon Lamarck's *Comatula multiradiata*, of which the only character given was the excess of the number of arms over 10. In 1841 Müller described the genus *Actinometra*, which was based upon the arrangement of the ambulacral grooves upon the disk and evidently intended to include all the exocyclic species, or comasterids. In 1866 Lovén instituted his new genus *Phanogenia*, the chief character of which was the great reduction of the centrodorsal and the absence of cirri, and in 1868 Semper described the genus *Ophiocrinus* (the name being preoccupied was subsequently changed by P. H. Carpenter to *Eudiocrinus*), including a species with only 5 arms.

In 1879 P. H. Carpenter proposed the genus *Promachocrinus*, including species with 10 instead of 5 radials; in 1881 the genus *Atelecrinus* with externally visible basals; and in 1884 the genus *Thaumatocrinus* with large orals, a completely plated disk, and interradials, of which the posterior bears a short jointed process.

Thus at the time of the publication of the *Challenger* report in 1888 there were in the literature the following 10 genera of comatulids:

Antedon.
Alecto.
Comatula.
Comaster.
Actinometra.
Phanogenia.
Ophiocrinus (*Eudiocrinus*).
Promachocrinus.
Atelecrinus.
Thaumatocrinus.

Of these Carpenter discarded, for various reasons, *Alecto, Comatula, Comaster*, and *Phanogenia*, dividing the 188 species known to him among the remainder in the following proportions:

Antedon, 122 species.
Actinometra, 54 species.
Eudiocrinus, 5 species.
Promachocrinus, 3 species.
Atelecrinus, 3 species.
Thaumatocrinus, 1 species.

The large number of species in the genera *Antedon* and *Actinometra* as understood by Carpenter induced him to group them in small intrageneric units, for which, however, he did not claim subgeneric rank.

The genus *Antedon*, on the basis of the type of articulation between the elements of the IBr series, the number of arms, the character of the IIBr series, the character of the proximal brachials, the presence or absence of a highly developed perisomic plating, and the character of the proximal pinnules, he divided into 4 "series," including 10 "groups," as follows:

Series I: *Elegans* group.
Series II: *Basicurva* group.
Acoela group.
Eschrichti group.
Tenella group.
Milberti group.
Series III: *Spinifera* group.
Palmata group.
Series IV: *Granulifera* group.
Savignyi group.

The genus *Actinometra*, on the basis of the type of articulation between the elements of the IBr series and (or) the first two brachials, the number of arms, the character of the IIBr and subsequent division series, and the position of the lowest pinnule, he divided into 4 "series" and 8 "groups," as follows:

Series I: *Solaris* group.
Paucicirra group.
Typica group.
Series II: *Echinoptera* group.
Series III: *Stelligera* group.
Valida group.
Series IV: *Fimbriata* group.
Parvicirra group.

In 1895 Hartlaub rearranged Carpenter's groups of *Antedon* in two "series," one containing species with, the other including species without, "plated ambulacra." In 1905 Minckert proposed the genus *Decametrocrinus* for those species included in Carpenter's genus *Promachocrinus* in which the arms are undivided.

Thus when I began work upon the comatulids in 1907, after my return from the North Pacific, I found Carpenter's monograph the standard work and the arrangement of the species adopted therein the accepted classification.

Naturally the earliest papers published after my arrival in Washington contained descriptions of the more extraordinary stalked crinoids brought to light by the investigations of the *Albatross*, since these were very much more easily determined than comatulids, and are of much greater general interest. The first paper (June 15, 1907) dealt with *Phrynocrinus nudus*, the type of a new genus which was made the type of a new family, and with *Bathycrinus pacificus*, the first species of that genus known from the Pacific, both collected in southern Japan at the end of the preceding August. On the same day there appeared another paper, in which the new genus

Ptilocrinus and the type species *Pt. pinnatus* were described, and an unfortunate confusion of names in the genus *Bathycrinus* rectified by the substitution of the name *Bathycrinus australis* for the *Bathycrinus aldrichianus* of the *Challenger* report, which is not the original *Bathycrinus aldrichianus* of Sir Wyville Thomson, the latter being called by Carpenter *Bathycrinus campbellianus*.

Ptilocrinus pinnatus had been collected by the *Albatross* in 1890, and I had come across it in looking over the undetermined material stored in the United States National Museum. Immediately after my return, and while I was busily engaged in preparing a report upon the birds which I had collected and observed, Mr. Frank Springer had, unknown to me, visited the Museum and had borrowed some of the specimens for study in connection with his work on the fossil species. He at once saw that he had found a remarkable new crinoid type, and it happened that his letter asking permission to describe it and the letter from the Bureau of Fisheries transmitting my manuscript reached the Museum at the same time. As soon as he learned of the coincidence Mr. Springer, with his characteristic generosity, withdrew his request.

In a third paper, published on the same date as the two preceding, all the specimens of *Eudiocrinus varians* and *E. japonicus* which had been collected in the summer of 1906 were recorded, and a new species, *E. tuberculatus*, was described, which had been collected by the *Albatross* in Japan in 1896 and which I found in the collections of the National Museum. At the end of the paper a list of all the known species of *Eudiocrinus* [that is, *Eudiocrinus*+*Pentametrocrinus*] was given.

On September 17, 1907, two papers were published in which a number of new species of comatulids from the North Pacific were described.

The new species in the first of these were the following:

Decametrocrinus borealis.
Antedon rara.
Antedon hartlaubi.
Antedon tenelloides.
Antedon asperrima.
Antedon perplexa.
Antedon laodice.
Antedon eschrichtii maxima.
Antedon inexpectata.
Antedon rathbuni.
Antedon brachymera.
Antedon serratissima.
Antedon mariae.
Antedon hondoensis.
Antedon clio.
Antedon erythrizon.
Antedon fragilis.
Antedon tenuis.
Antedon ciliata.
Antedon isis.
Antedon arctica.
Antedon briseis.

All but two of these were stated in the introduction to have been collected on the 1906 cruise of the *Albatross*, but in the text *Antedon arctica* is recorded as having been collected by Maj. Gen. A. W. Greeley in 1886, and *Antedon inexpectata, A. perplexa, A. asperrima*, and *A. serratissima* were said to have been dredged by the *Albatross* in 1888, 1889, 1890, and 1891. The discrepancy is explained by the fact that three of these descriptions were added while the paper was going through the press.

Mention was made of the capture of enormous numbers of *Antedon eschrichtii* var. *maxima*, and Lamarck's name *Comatula* was reinstated in place of *Actinometra* as used by P. H. Carpenter and all subsequent authors.

While the paper just mentioned dealt with forms belonging to the *Elegans*, *Eschrichti*, and *Tenella* groups of Carpenter, the new species described in the second paper were mainly members of the *Acoela*, *Basicurva*, *Spinifera*, and *Palmata* groups of Carpenter, and of the *Multicolor* group, a new group formed for the reception of species related to *Antedon discoidea* but "bidistichate," that is, with IIBr 2 series; in addition to these there were included three 10-armed species with no pinnule on the "third brachial" (the epizygal of the first syzygial pair), another species of the *Elegans* group, and three species of *Comatula*. A species of *Comatula* and another of *Atelecrinus* were renamed.

In the key to the new species described, *Antedon quinquecostata* is inserted for comparison with *A. diadema*. The species referred to is a Japanese form, which subsequently proved to be the fully grown of *A. diadema*.

The colors of the various species in life receive especial attention.

The new species and new names appearing in this paper are:

Antedon multicolor.
Antedon versicolor.
Antedon propinqua.
Antedon separata.
Antedon flavopurpurea.
Antedon callista.
Antedon anthus.
Antedon macropoda.
Antedon hana.
Antedon villosa.
Antedon pubescens.
Antedon hepburniana.
Antedon lata.
Antedon scalaris.
Antedon garrettiana.
Antedon orion.
Antedon minor.
Antedon diadema.
Antedon aster.
Antedon alboflava.
Antedon ruber.
Antedon diomedeae.
Antedon tigrina.
Antedon bowersi.
Antedon abbotti.
Antedon stylifer.
Antedon delicatissima.
Antedon rubroflava.
Antedon thetis.
Antedon hawaiiensis.
Comatula mariae.
Comatula solaster.
Comatula serrata.
Comatula orientalis (new name).
Atelecrinus pourtalèsi (new name).

Of the 33 new species described, all were collected by the *Albatross* in 1906, except *Antedon tigrina*, from the United States North Pacific Exploring Expedition; *A. abbotti*, received from Dr. W. L. Abbott; *A. thetis*, collected by the *Albatross* in 1900; and *A. hawaiiensis*, collected by the *Albatross* in 1891.

On October 29 two papers appeared. The first contained descriptions of four new comatulids from southern Japan and the description of a new stalked crinoid from Kamchatka, all collected by the *Albatross* in 1900. On the 1900 cruise the *Albatross* collected about 300 crinoids on the southern Japanese coast, mostly in the vicinity of Sagami Bay, which were assigned to Dr. Hubert Lyman Clark for study and report. When in Cambridge in the summer of 1907 I told him that I was engaged in describing the crinoids of the 1906 cruise and that the diagnoses of many of my new species were already going through the press, and he immediately insisted that I take over those which had been sent to him for study along with my own much larger collection. The new species given in this paper, the descriptions of which were prepared at Cambridge, are the following:

Bathycrinus complanatus.
Zygometra koehleri.
Antedon adrestine.
Antedon minuta.
Antedon orientalis.

The generic name *Zygometra* appears in this paper for the first time, without diagnosis, but used in the description of *Z. koehleri*, which therefore becomes the type. The family name Antedonidae also appears in the text in place of the more familiar Comatulidae or Comatulae.

The second paper was a rearrangement of the comatulids previously assigned to the genus *Antedon*, which were distributed among 18 genera, all of which, excepting *Antedon*, were new.

The fact is mentioned that since the publication of the *Challenger* monograph the family Comatulidae as understood by P. H. Carpenter has been broken up into the families Thaumatocrinidae (*Thaumatocrinus*), Antedonidae (including *Eudiocrinus*, *Antedon*, and *Thiolliericrinus*), Atelecrinidae (*Atelecrinus*), Actinometridae (*Comatula*), and Decametrocrinidae (*Promachocrinus* and *Decametrocrinus*). The family Decametrocrinidae was found to be an unnatural combination, for *Decametrocrinus* is most nearly related to *Eudiocrinus*. It is therefore rejected, and a new family, Eudiocrinidae, proposed to include *Eudiocrinus* and *Decametrocrinus*. *Promachocrinus* is left unassigned. Minckert's *Brevipinna* group, a connecting link between the *Spinifera* and *Granulifera* groups, is mentioned.

The new genera proposed were the following:

Zygometra (genotype *Antedon microdiscus* Bell, 1884) including

Zygometra elegans.
Zygometra hartlaubi.
Zygometra koehleri.
Zygometra microdiscus.
Zygometra multiradiata.
Zygometra rubroflava.

Zygometra was said to correspond to Carpenter's *Elegans* group, or Series I of *Antedon*, and it was recalled that Lovén's genus *Hyponome* was based upon a detached visceral mass of an unidentifiable species of this genus.

Nanometra (genotype *Antedon minor* A. H. Clark, 1907) including

Nanometra denticulata.
Nanometra minckerti.
Nanometra pusilla.
Nanometra wilsoni.

Nanometra includes those species of Carpenter's *Basicurva* group which lack the plating of the ambulacra.

Tropiometra (genotype *Comatula carinata* Lamarck, 1816) including

Tropiometra afra.
Tropiometra carinata.
Tropiometra braziliensis.
Tropiometra macrodiscus.

Tropiometra is equivalent to a part of Carpenter's *Milberti* group.

Heliometra (genotype *Alecto eschrichtii* J. Müller, 1841) including

Heliometra antarctica.
Heliometra asperrima.
Heliometra brachymera.
Heliometra clio.
Heliometra eschrichtii.
Heliometra glabra.
Heliometra hondoensis.
Heliometra inexpectata.
Heliometra juvenalis.
Heliometra laodice.
Heliometra magellanica.
Heliometra mariae.
Heliometra maxima.
Heliometra perplexa.
Heliometra quadrata.
Heliometra rathbuni.
Heliometra rhomboidea.
Heliometra serratissima.
Heliometra tanneri.

Heliometra corresponds to the *Eschrichti* group of Carpenter.

Thysanometra (genotype *Antedon tenelloides* A. H. Clark, 1907) including

Thysanometra tenelloides.

Psathyrometra (genotype *Antedon fragilis* A. H. Clark, 1907) including

Psathyrometra bigradata.
Psathyrometra erythrizon
Psathyrometra fragilis.

Zenometra (genotype *Antedon columnaris* P. H. Carpenter, 1881) including

Zenometra columnaris.

Pontiometra (genotype *Antedon andersoni* P. H. Carpenter, 1889) including

Pontiometra andersoni.

Himerometra (genotype *Antedon crassipinna* Hartlaub, 1890) including

Himerometra abbotti.
Himerometra affinis.
Himerometra anceps.
Himerometra articulata.
Himerometra bella.
Himerometra bengalensis.
Himerometra bidens.
Himerometra bimaculata.
Himerometra brevicuneata.
Himerometra brockii.
Himerometra clemens.
Himerometra crassipinna.
Himerometra delicatissima.
Himerometra döderleini.
Himerometra elongata.
Himerometra emendatrix.
Himerometra erinacea.
Himerometra finschii.
Himerometra flagellata.
Himerometra gyges.
Himerometra helianthus.
Himerometra imparipinna.
Himerometra indica.
Himerometra klunzingeri.
Himerometra kraepelini.
Himerometra laevicirra.
Himerometra ludovici.
Himerometra marginata.
Himerometra martensi.
Himerometra milberti.
Himerometra monacantha.
Himerometra nematodon.
Himerometra occulta.
Himerometra okelli.
Himerometra oxyacantha.
Himerometra palmata.

Himerometra persica.
Himerometra philiberti.
Himerometra regalis.
Himerometra reginae.
Himerometra quinduplicava.
Himerometra reynaudii.
Himerometra savignii.
Himerometra spicata.
Himerometra spinipinna.
Himerometra stylifer.
Himerometra subtilis.
Himerometra tenera.
Himerometra tenuipinna.
Himerometra tessellata.
Himerometra tuberculata.
Himerometra variipinna.

The genus *Himerometra* includes parts of Carpenter's *Milberti*, *Palmata*, and *Savignyi* groups.

Cyllometra (genotype *Antedon manca* P. H. Carpenter, 1888) including

Cyllometra impinnata.
Cyllometra informis.
Cyllometra belli.
Cyllometra manca.
Cyllometra perspinosa.
Cyllometra ruber.
Cyllometra tigrina.

Cyllometra includes one species placed by Carpenter in the *Milberti* group near *milberti*, two placed at the end of the *Milberti* group, and one placed in the unassigned list at the end of the 10-armed species.

Perometra (genotype *Antedon diomedeae* A. H. Clark, 1907) including

Perometra balanoides.
Perometra diomedeae.

Ptilometra (genotype *Alecto* [lapsus calami; Müller used *Comatula*] *macronema* J. Müller, 1841 [should have been 1846]) including

Ptilometra anthus.
Ptilometra longicirra.
Ptilometra macronema.
Ptilometra macropoda.

In the discussion of the genus *Ptilometra* it is stated that *Antedon anthus*, *A. longicirra*, and *A. macropoda* were originally assigned to a new genus *Asterometra*, but that it was later decided to place them in *Ptilometra*.

Thalassometra (genotype *Antedon villosa* A. H. Clark, 1907) including

Thalassometra acutiradia.
Thalassometra agassizii.
Thalassometra alboflava.
Thalassometra aster.
Thalassometra bispinosa.
Thalassometra breviradia.
Thalassometra diadema.
Thalassometra duplex.
Thalassometra echinata.
Thalassometra hana.
Thalassometra hawaiiensis
Thalassometra incerta.
Thalassometra latipinna.
Thalassometra lusitanica
Thalassometra multispina.
Thalassometra pergracilis.
Thalassometra pubescens.
Thalassometra quinquecostata.
Thalassometra spinicirra.
Thalassometra spinifera.
Thalassometra valida.
Thalassometra villosa.
Thalassometra wood-masoni.

Thalassometra includes the larger part of Carpenter's *Basicurva* group, together with part of his *Spinifera* group and a species placed by him in the *Granulifera* group (in addition to being in the *Basicurva* group).

Charitometra (genotype *Antedon incisa* P. H. Carpenter, 1888) including

Charitometra aculeata.
Charitometra angusticalyx.
Charitometra basicurva.
Charitometra brevipinna.
Charitometra compressa.
Charitometra distincta.
Charitometra flexilis.
Charitometra garrettiana.
Charitometra granulifera.
Charitometra hepburniana.
Charitometra inaequalis.
Charitometra incisa.
Charitometra lata.
Charitometra orion.
Charitometra parvipinna.
Charitometra patula.
Charitometra pourtalèsi.
Charitometra robusta.
Charitometra tuberosa.

Charitometra includes most of the species placed by Carpenter in the *Basicurva*, *Spinifera*, and *Granulifera* groups not falling in the genus *Thalassometra*.

Poecilometra (genotype *Antedon acoela* P. H. Carpenter, 1888) including

Poecilometra acoela.
Poecilometra scalaris.

Poecilometra includes a species described in the *Acoela* group by Carpenter and another described by the author in the *Basicurva* group. The inappropriateness of the generic name is due to the fact that at first (before publication) it was applied to the presumably homogeneous *Acoela* group as a whole, in which *Antedon discoidea*, variegated in color, was the more distinctive species. When the close relationships of *Antedon discoidea* with the Japanese forms which I had tentatively grouped under the generic name *Calometra* were discovered, this species was removed from *Poecilometra*, leaving *Antedon acoela* as the type.

Calometra (genotype *Antedon callista* A. H. Clark, 1907) including

Calometra bassett-smithi.
Calometra callista.
Calometra discoidea.
Calometra flavopurpurea.
Calometra multicolor.
Calometra propinqua.
Calometra separata.
Calometra thetis.
Calometra versicolor.

The only species known to Carpenter was placed by him in the *Acoela* group; another species was said to have been placed by Bell in the *Spinifera* group.

Adelometra (genotype *Antedon angustiradia* P. H. Carpenter, 1888) including

Adelometra angustiradia

The genus *Adelometra* includes a species from Carpenter's *Savignyi* group.

Antedon as restricted and redefined, being now practically equivalent to Carpenter's *Tenella* group with the addition of *Antedon pumila* and *A. parvicirra* from the *Milberti* group, includes the following species:

Antedon abyssicola.
Antedon abyssorum.
Antedon adeonae.
Antedon adrestine.
Antedon alternata.
Antedon angustipinna.
Antedon arctica.
Antedon bifida.
Antedon briseis.
Antedon carpenteri.

Antedon challengeri.
Antedon ciliata.
Antedon dentata.
Antedon dübeni.
Antedon exigua.
Antedon hirsuta.
Antedon hupferi.
Antedon isis.
Antedon japonica.
Antedon laevis.
Antedon longipinna.
Anedon minuta.
Antedon nana.
Antedon orientalis.
Antedon parvicirra.
Antedon parvula.
Antedon phalangium.
Antedon prolixa.
Antedon psyche.
Antedon pumila.
Antedon remota.
Antedon serrata.
Antedon serripinna.
Antedon stella.
Antedon tenella.
Antedon tenuicirra.

The new specific names published in this paper are the following:

Nanometra minckerti, new name for *Antedon minor* A. H. Clark, 1907, preoccupied (by a fossil species).

Heliometra glabra, new name for *Antedon australis* P. H. Carpenter, 1888, not *Antedon australis* P. H. Carpenter, 1882.

Antedon challengeri, new name for *Antedon lineata* P. H. Carpenter, 1888, not *Antedon lineatus* Pomel, 1887.

Antedon stella, new name for *Antedon tenuis* A. H. Clark, 1907, not *Antedon tenuis* P. H. Carpenter, 1887.

Cyllometra belli, new name for *Antedon lovéni* Bell, 1884, not *Antedon lovéni* Bell, 1882.

Thalassometra pergracilis, new name for *Antedon gracilis* P. H. Carpenter 1888, preoccupied.

The following are *nomina nuda:*

Heliometra juvenalis.
Himerometra persica.
Himerometra helianthus.
Antedon psyche.
Antedon serrata.

Bell's *Antedon capensis*, recently described, is identified, from specimens sent by Professor Bell to the Museum of Comparative Zoölogy and there examined, as *Tropiometra carinata.*

Cyllometra manca as the name is used in the discussion of the genus *Heliometra* refers to the Japanese *C. albopurpurea*, not then recognized as a distinct species.

In a paper published at Cambridge, Mass., in January, 1908, eight new species are described; new records for *Heliometra rhomboidea* (west coast of Central America) and *Psathyrometra*, sp. (Galápagos Islands) were published; the occurrence of 6-rayed specimens of *Tropiometra carinata* at Rio de Janeiro and the prevalence of this variation among the crinoids generally were discussed; a key to the species of the genus *Bathycrinus* was given, together with a table of the bathymetrical, thermal, and geographical ranges of these species; and a key to the genera (with the genotypes) into which the genus *Antedon* was divided in the preceding paper is appended. In this key *Asterometra* is given full recognition; a new genus, *Stylometra*, with the genotype *Antedon spinifera*, is included; and the type of *Ptilometra* is correctly given as *Comatula* (instead of *Alecto*) *macronema*.

The eight new species described were—

Bathycrinus equatorialis.
Bathycrinus caribbeus.
Heliometra juvenalis.
Antedon serrata.
Antedon psyche.
Himerometra acuta.
Himerometra heliaster.
Himerometra persica.

It was at this time commonly assumed that no infrabasals existed in the recent pentacrinites. *Pentacrinus wyvillethomsoni* had been minutely examined by the two Carpenters, and no trace of such plates had been found. On the other hand, de Loriol had figured small infrabasals in *Isocrinus leuthardi*, which is closely related to several recent species. One day in the late spring of 1907, as a temporary relief from the exacting detailed work involved in the intensive study of the comatulids, the author decided to look into the question for himself. Dissections were made of some specimens of *Isocrinus decorus* collected in the West Indies by the *Albatross* in her early days and of specimens of *Metacrinus rotundus* and of *M. superbus* from the 1906 cruise. Infrabasals were found in all three, and during the next two days figures were drawn and a short account of the discovery, together with a summary of the status of infrabasals in the recent crinoids, was prepared which was immediately submitted for publication. This paper did not appear until February 29, 1908, and in the meantime, in November, 1907, Döderlein's memoir on the stalked crinoids of the *Siboga* expedition appeared in which the infrabasals of *Metacrinus* were described and figured. Thus the discovery of the occurrence of infrabasals in the recent pentacrinites was made independently and simultaneously by Professor Döderlein and the present author.

In this paper the following stalked crinoids are mentioned as occuring in the Eastern Sea, near Kagoshima, Japan:

Metacrinus rotundus.
Metacrinus angulatus.
Metacrinus superbus.

A study of the species included by Carpenter in the genus *Actinometra* seemed to show the advisability of dividing that genus, and on February 29, 1908, a paper was published in which such a division was attempted. Two genera were recognized, based upon the type of articulation between the elements of the IBr and first two elements of the IIBr series, *Comatula* Lamarck (with the genotype *Comatula solaris* Lamarck) and *Comaster* L. Agassiz (of which the genotype is given as *Comatula multiradiata* Lamarck = *Asterias multiradiata* Linné, 1758, and Retzius, 1783, but not *Comatula multiradiata* Goldfuss [= *Alecto novae-guineae* Müller]).

The following species are assigned to *Comatula:*

Comatula distincta.
Comatula multibrachiata.
Comatula notata.
Comatula paucicirra.
Comatula pectinata.
Comatula serrata.
Comatula solaris.

The following species were assigned to *Comaster:*

Comaster alata.
Comaster alternans.
Comaster belli.
Comaster bennetti.
Comaster borneensis.
Comaster briareus.
Comaster carpenteri.
Comaster coppingeri.
Comaster discoidea.
Comaster divaricata.
Comaster duplex.
Comaster echinoptera.
Comaster elongata.
Comaster fimbriata.
Comaster gracilis.
Comaster grandicalyx.
Comaster iowensis.
Comaster lineata.
Comaster japonica.
Comaster littoralis.
Comaster macrobrachius.
Comaster maculata.
Comaster magnifica.
Comaster mariae.
Comaster meridionalis.
Comaster multiradiata.
Comaster nobilis.
Comaster novaeguineae.
Comaster orientalis.
Comaster parvicirra.
Comaster peronii.
Comaster quadrata.
Comaster regalis.
Comaster robustipinna.
Comaster rotalaria.
Comaster rubiginosa.
Comaster schlegelii.
Comaster sentosa.
Comaster solaster.
Comaster stelligera.
Comaster trichoptera.
Comaster typica.
Comaster valida.
Comaster variabilis.

The name (*Actinometra*) *pulchella* as used by P. H. Carpenter was shown to be unavailable, and the alternative name *alata* was proposed for the species.

The new name *Comaster carpenteri* was suggested for *Actinometra multifida* as diagnosed by Carpenter in the *Challenger* report. Müller proposed the name *multifida* merely as a substitute for Lamarck's *multiradiata.* His idea was that, two quite different species having been called *multiradiata,* one by Lamarck and one by Goldfuss, the name should hold for that with the recognizable diagnosis; so he restricted it to Goldfuss's species. Subsequently he examined Lamarck's original types, and from one of them he drew up his diagnosis of *multifida.* According to Carpenter, Lamarck's *multiradiata* is the *multiradiata* of Linné and of Retzius; but he resurrected the name *multifida* for a specimen which was among Lamarck's types and which differed both from the *multiradiata* of Lamarck and the *multiradiata* of Goldfuss. But *multifida* is a synonym of *multiradiata* Lamarck and can not be used for any other species. Hence the name *carpenteri* is proposed to cover the form called *multifida* by Carpenter.

In this paper attention was called to the fact that the *Encrinus parrae* of Guérin [in reality Paul Gervais—the article is signed merely "P. G."], 1835, based on the "Palma animal" of Parra, 1787, is the same as the *Pentacrinus mülleri* described by Örsted in 1856.

Guilding's *Encrinus milleri,* described from St. Vincent in 1828, is stated to be an unrecognizable species; the name also is preoccupied.

The revision of the old genus *Antedon* had not proved entirely satisfactory; in particular, the genus *Antedon* as there restricted was too heterogeneous, and on April 11, 1908, a paper was published in which 12 additional genera were proposed. These new genera, of which the geographical and bathymetrical ranges as well as the colors were given, were the following:

Oligometra (genotype *Antedon serripinna* P. H. Carpenter, 1881) including

Oligometra adeonae.
Oligometra bidens.
Oligometra caribbea.
Oligometra japonica.
Oligometra pinniformis.
Oligometra serripinna.
Oligometra carpenteri.

Erythrometra (genotype *Antedon ruber* A. H. Clark, 1907) including

Erythrometra ruber.

Thaumatometra (genotype *Antedon ciliata* A. H. Clark, 1907 [=*Antedon tenuis* A. H. Clark, 1907]) including

Thaumatometra abyssorum.
Thaumatometra alternata.
Thaumatometra comaster.
Thaumatometra exigua.
Thaumatometra hirsuta.
Thaumatometra isis.
Thaumatometra laevis.
Thaumatometra longipinna.
Thaumatometra parva.
Thaumatometra parvula.
Thaumatometra remota.

Coccometra (genotype *Comatula hagenii* Pourtalès, 1869) including

Coccometra hagenii.

Coccometra nigrolineata (=*Antedon hagenii* of H. L. Clark [not *hagenii* Pourtalès], 1901).

Leptometra (genotype *Alecto phalangium* J. Müller, 1841) including

Leptometra celtica.
Leptometra phalangium.

Hathrometra (genotype *Alectro dentata* Say, 1825) including

Hathrometra dentata.
Hathrometra prolixa.
Hathrometra sarsii.
Hathrometra tenella.

Iridometra (genotype *Antedon adrestine* A. H. Clark, 1907) including

Iridometra adrestine.
Iridometra briseis.
Iridometra crispa.
Iridometra minuta.
Iridometra nana.
Iridometra parvicirra.
Iridometra psyche.

Compsometra (genotype *Antedon lovéni* Bell, 1882 [=*A. pumila* Bell, 1884]) including

Compsometra lovéni.
Compsometra serrata.

Trichometra (genotype *Antedon aspera* A. H. Clark, 1908) including

Trichometra aspera.
Trichometra vexator.

Bathymetra (genotype *Antedon abyssicola* P. H. Carpenter, 1888) including

Bathymetra abyssicola.
Bathymetra brevicirra.
Bathymetra carpenteri.
Bathymetra minutissima.

Hypalometra (genotype *Antedon defecta* P. H. Carpenter, 1888) including

Hypalometra defecta.

Isometra (genotype *Antedon lineata* P. H. Carpenter, 1888 [=*Antedon angustipinna* P. H. Carpenter, 1888]) including—

Isometra angustipinna.

Nomina nuda given in the preceding lists are—

Oligometra caribbea.
Thaumatometra comaster.
Thaumatometra parva.
Iridometra crispa.
Trichometra vexator.
Bathymetra brevicirra.
Bathymetra carpenteri.
Bathymetra minutissima.
Trichometra aspera.

and further on in the paper

Eudiocrinus variegatus.

The new name *Coccometra nigrolineata* was also used. This name had been applied (in MS.) to a species from the West Indies represented by a number of specimens in the National Museum collections to which H. L. Clark's specimen of *Antedon hagenii* from Porto Rico belonged.

The new genus *Pentametrocrinus* was proposed to include all the described species of *Eudiocrinus* except *E. indivisus*, *E. granulatus*, and *E. variegatus*, and the following species were assigned to it:

Pentametrocrinus atlanticus.
Pentametrocrinus japonicus.
Pentametrocrinus semperi.
Pentametrocrinus tuberculatus.
Pentametrocrinus varians.

Pentametrocrinus was found to be closely related to *Decametrocrinus* and the two were united in the family Pentametrocrinidae, to which *Thaumatocrinus* was also added.

Eudiocrinus indivisus, *E. granulatus*, and *E. variegatus* were found to be related to the species of *Zygometra*, and *Eudiocrinus* was placed with *Zygometra* in the family Zygometridae.

The proximal arm structure of *Eudiocrinus*, *Pentametrocrinus*, and *Uintacrinus* was discussed in detail, and the costals (IIBr series) of the comatulids were said to be merely repetitions of the first two brachials of the free arms interpolated between the regular first brachials and the radials; the distichals (IIIBr) and palmars (IVBr) are additional reduplications of the first two brachials, either single (2) or double (4 [3+4] or 4 [1+2; 3+4]).

In the generic diagnoses the articular faces of the radials were described in detail in the genera *Erythrometra*, *Thaumatometra*, *Coccometra*, *Leptometra*, *Hathrometra*, *Trichometra*, and *Hypalometra*.

The pinnules of *Calometra* were said to be triangular in cross section and not cylindrical as previously given; this was determined only after the examination of dried material.

Antedon dübenii, previously placed in *Antedon*, is here stated to be merely the young of *Tropiometra carinata*.

Antedon tenuicirra is assigned to *Thysanometra*, and it is suggested that it is possibly the young of *T. tenelloides*.

Antedon compressa and *A. orion*, previously placed in *Charitometra*, are here transferred to *Thalassometra*. *Antedon flava* of Koehler and *A. porrecta* of Carpenter are also placed in *Thalassometra*.

Antedon sclateri of Bell is placed in *Charitometra* near *C. inaequalis*, and *A. magnicirra* is assigned to *Thalassometra*.

Isometra angustipinna is said to be without doubt the young of *Antedon lineata* P. H. Carpenter, 1888 (not *Antedon lineatus* Pomel, 1887).

The comatulids as a whole are considered as forming the group Comatulida, which is divided into the following families:

Uintacrinidae, including *Uintacrinus*.

Comasteridae, including *Comatula* and *Comaster*.

Zygometridae, including *Eudiocrinus* and *Zygometra*.

Himerometridae, including *Himerometra*, *Pontiometra*, *Cyllometra*, and *Oligometra*.

Tropiometridae, including *Tropiometra*, *Asterometra*, *Calometra*, and *Ptilometra*.

Thalassometridae, including *Poecilometra*, *Thalassometra*, and *Charitometra*.

Antedonidae (restricted), including *Perometra*, *Erythrometra*, *Zenometra*, *Psathyrometra*, *Adelometra*, *Heliometra*, *Promachocrinus*, *Thaumatometra*, *Thysanometra*, *Coccometra*, *Leptometra*, *Hathrometra*, *Iridometra*, *Trichometra*, *Bathymetra*, *Nanometra*, *Compsometra*, *Hypalometra*, *Isometra*, and *Antedon*.

Pentametrocrinidae, including *Decametrocrinus*, *Pentametrocrinus*, and *Thaumatocrinus*.

A paper published on May 4, 1908, contained descriptions of two new stalked crinoids from the Atlantic coast of the United States. These were—

Bathycrinus serratus.
Rhizocrinus verrilli.

Both of these had been mentioned by Verrill in 1885, and the latter figured, but neither had been described.

The upper portions of the columns of *Bathycrinus equatorialis* and of *B. caribbeus* were figured, and the relationship between *Bathycrinus* and *Rhizocrinus* was discussed.

After the return of the *Albatross* from her detailed investigations among the Hawaiian Islands in 1902 the comatulids obtained, together with the starfishes and ophiurans, were assigned to Prof. Walter K. Fisher of Stanford University, Calif., for description. Learning of my interest in these animals, Professor Fisher most generously sent me the entire collection, which forms the basis of a paper published on May 14, 1908.

This paper begins with a key to all the comatulid families, collectively considered as making up the order Comatulida, which have recent representatives. A list of the families with the included genera and the geographical and bathymetrical ranges follows. They are—

Thuamatocrinidae, including *Thaumatocrinus.*

Atelecrinidae, including *Atelecrinus.*

Eudiocrinidae, including *Eudiocrinus* and *Decametrocrinus.*

Thalassometridae, including *Thalassometra, Stylometra, Charitometra,* and *Poecilometra.*

Tropiometridae, including *Tropiometra, Ptilometra, Asterometra,* and *Calometra.*

Antedonidae (restricted), including *Antedon, Thysanometra, Coccometra, Heliometra, Promachocrinus, Trichometra, Adelometra, Psathyrometra, Zenometra, Hypalometra, Isometra, Bathymetra, Thaumatometra, Hathrometra, Leptometra, Compsometra, Iridometra, Nanometra, Erythrometra,* and *Perometra.*

Himerometridae, including *Oligometra, Cyllometra, Himerometra,* and *Pontiometra.*

Zygometridae, including *Zygometra.*

Comasteridae, including *Comaster and Comatula.*

Two other families of Comatulida, both fossil only, are mentioned, the Thiolliericrinidae and the Uintacrinidae, each containing only a single genus representing respectively the least and most specialized types in the order.

The species given from the Hawaiian Islands, all but *Thalassometra hawaiiensis* new, are:

Atelecrinus conifer.
Decametrocrinus rugosus.
Trichometra vexator.
Iridometra crispa.
Zenometra triserialis.
Psathyrometra congesta.
Thalassometra hawaiiensis.
Thalassometra gigantea.
Thalassometra fisheri.
Thalassometra crassicirra.
Thalassometra delicata.
Charitometra lateralis.

The Hawaiian fauna is compared in detail with that of the West Indies, Japan, and the Crozet, Aleutian, and Galápagos Islands. It is stated that specimens of species of Comasteridae and Himerometridae have been recorded from, and exist in collections as having been obtained in, the Hawaiian Islands, but that these have probably been brought as "curios" to Honolulu from Japan or Samoa and there sold as having been secured in the Hawaiian Islands.

Additional species described in an appendix to this paper are:

Trichometra aspera.
Thaumatometra parva.
Thaumatometra comaster.
Bathymetra minutissima.
Bathymetra brevicirra.
Bathymetra carpenteri.
Adelometra tenuipes.
Psathyrometra borealis.
Psathyrometra profundorum.
Zenometra pyramidalis.
Himerometra subcarinata.
Oligometra caribbea.
Cyllometra albopurpurea.

It will be noticed that the names of many of the new species described in this paper occur as *nomina nuda* in the paper published on April 11, and that the family Eudiocrinidae here accepted was in that paper shown to be untenable. This is explained by the fact that the paper published on May 14 was written prior to that published on April 11.

For some time the author had been investigating the homologies of the postradial elements in the comatulids, and certain definite conclusions had been drawn of which the most important was that the IBr and following division series are in reality nothing more than reduplications of the first two brachials interpolated between the original first two brachials and the radials. This observation was published in the paper containing the second installment of new genera formed within the old genus *Antedon* as understood by P. H. Carpenter (April 11) in which also the difference in arm structure between the type of *Eudiocrinus indivisus* and *E. japonicus* is explained. Applying to the pentacrinites the facts discovered regarding the arm structure of the comatulids, it was at once seen that the genus *Isocrinus* (=*Pentacrinus* as understood by Carpenter) was not a homogeneous entity, but is made up of several distinct types.

In a paper which appeared on June 9, 1908, the arm structure of the pentacrinites was discussed in detail and compared with that of the comatulids. Two new genera were proposed:

Endoxocrinus (genotype *Encrinus parrae* Guérin [that is, Gervais], 1835 [=*Pentacrinus mülleri* Örsted, 1856]) including

Endoxocrinus alternicirrus.
Endoxocrinus parrae.
Endoxocrinus sibogae.
Endoxocrinus wyville-thomsoni.

Hypalocrinus (genotype *Pentacrinus naresianus* P. H. Carpenter, 1882) including
Hypalocrinus naresianus.

This leaves the following three recent species in *Isocrinus:*

Isocrinus (*Cenocrinus*) *asteria.*
Isocrinus (*Isocrinus*) *blakei.*
Isocrinus (*Isocrinus*) *decorus.*

It is suggested that the young of *Metacrinus* will be found to possess 5 arms only in contrast to the 10 arms of the young of the other recent pentacrinites.

The species recorded by Reichensperger as "*Pentacrinus decorus*" in which he figures the axial canals is redetermined as *Endoxocrinus parrae.*

In the diagnosis of *Endoxocrinus* the following statement is made: "infrabasals always (?) absent, and interior ends of basals more or less resorbed, the primary axial canals forking and entering the basals through two apertures."

Endoxocrinus parrae, which inhabits the shallowest water of any of the genus, is extraordinarily variable, while the other species are pretty constant in their characters; this is said to accord with the rule that a species of a genus which occupies a habitat on the borders of the habitat of the genus as a whole, either geographically or bathymetrically, is more variable than are the other species of the same genus;

thus *Rhizocrinus lofotensis* and the corresponding species on the American coast are very commonly 6-rayed, while the numerous species of the same genus within the normal tropical area are invariably 5-rayed, and the most variable species of *Metacrinus*, *M. rotundus*, is also the most northerly of the genus; it is the same with species; the examples taken farthest from the center of distribution, or at the limits of distribution, are the most variable; *Tropiometra carinata*, constant in its characters from east Africa to Oceania, is extremely variable in Brazil; *Antedon bifida* is more variable about the British coasts than in the Mediterranean, and *Heliometra eschrichtii* varies most along the southern limit of its range.

In a paper published on June 16, 1908, some cases of abnormal arm structure in the crinoids are described.

A 6-armed specimen of *Rhizocrinus lofotensis* from off the southern United States is recorded.

The only specimen of *Poccilometra acoela* dredged by the *Albatross* off southern Japan has a third costal (IBr element) inserted between the normal two on one of the rays, as was the case in a specimen of *Thaumatometra alternata* dredged by the *Challenger* just north of New Guinea. The use of the name *Poecilometra acoela* for the specimen described as the type of *Antedon* [*Poecilometra*] *scalaris* indicates that the latter is now considered a synonym of the former.

Mr. Frank Springer in his monograph on *Uintacrinus* figured a specimen of *U. socialis* with four costals on one ray, an additional pair being inserted between the normal costals and the first brachials. From the shape and proportions of these additional costals it is stated that one might almost infer that they were united by syzygy, in which case the costal series would be directly comparable to the distichal (IIBr) series in comatulids with 4 (3+4) distichals. The presence of 4 (3+4) costals has only once been detected, but there is no reason to believe that it does not more or less commonly occur.

A case of distal arm division in a specimen of *Himerometra stylifer* from Kagoshima Bay, Japan (obtained by the United States Exploring Expedition and not previously recorded) is described, and the difference between this type of arm branching and that occurring at the base of the arms is discussed.

An instance of three succeeding proximal pinnules on the same side of the arm in *Charitometra imbricata* (new name) (=*Antedon granulifera* P. H. Carpenter, 1888, not *Antedon granulifera* Pourtalès, 1878=*Comatula brevipinna* Pourtalès, 1869=*Antedon pourtalèsi* P. H. Carpenter, 1888) is given.

The reasons for the use of the new name *imbricata* are not given further, but they were as follows.

Pourtalès originally bestowed the name *brevipinna* upon a young specimen of a species of *Crinometra* on which "one of the arms is abortive and divided into three very short branches; to compensate, one of the arms of the next pair is divided into two from its origin;" in other words, it was undergoing adolescent autotomy.

In the *Challenger* report *pourtalèsi* is diagnosed by Carpenter as follows: IIBr 2; "15–20 stout cirrus joints; cirri without definite arrangement; the distichals and lower brachials have distinctly flattened sides; the later cirrus joints smooth; calyx and arm bases irregularly tubercular; the pinnules from the tenth to the twentieth brachials have the third-fifth joints flattened and expanded laterally."

According to Carpenter, *brevipinna* differs from *pourtalèsi* in having "the genital pinnules comparatively slender, with very slightly expanded joints."

The difference between *pourtalèsi* and *brevipinna* as given by Carpenter is merely one of age; they are therefore identical.

Pourtalès' *granulifera* was fully grown; it had "bead-like tubercles" which are "found generally on the radials [that is, IBr series]" and "five knobs projecting into the interambulacral spaces [the ends of the basal rays]." The name *granulifera* indicates a species more or less covered with granules.

But in the *Challenger* report we find this diagnosis of *granulifera*: IIBr 4 (3+4); "a syzygy between the first two brachials; calyx and arm bases not spinous; the first two pinnules about equal, with compressed and carinate joints; the genital pinnules have unequally expanded joints; the distichal axillaries of adjacent rays partially separated by the pinnule of the preceding joint; palmars [IIIBr series] usually present; the second syzygy from the twentieth to the twenty-fifth brachial." As nothing is said about any ornamentation, and as *granulifera* is paired with (*Pachylometra*) *distincta*, a smooth species which is said to differ only in having "the lower pinnules comparatively slender," the inference is that Carpenter considered *granulifera* an unornamented species.

Moreover in the Museum of Comparative Zoölogy at Cambridge there is a jar containing fragments of an unornamented species with the label "*Antedon granulifera*" in Pourtalès' hand writing, and apparently Carpenter had this specimen in mind when he rediagnosed *granulifera*.

But in the Museum of Comparative Zoölogy there is a second beautiful specimen without a label which I take to be in reality the type of *granulifera*.

As described by Pourtalès *granulifera* can not be distinguished from *pourtalèsi* as diagnosed by Carpenter, nor does it appear to differ from the young *brevipinna* of Pourtalès.

But the *granulifera* of Carpenter is evidently not the *granulifera* of Pourtalès, and on the basis of the diagnosis in the *Challenger* report was therefore renamed *imbricata*.

A specimen of *Heliometra tanneri* is recorded with an additional first and second brachial on one arm which is described as a distichal (IIBr) series with the more distal element of the pair not axillary.

A 12-armed specimen of *Heliometra maxima* from southern Sakhalin Island is described, which gives added weight to the idea of the close relationship between *Heliometra* and *Promachocrinus*, first worked out on the basis of the arm and pinnule structure, and the structure of the articular faces of the radials. It is noted that P. H. Carpenter has recorded the occurrence of a single radial bearing two costal (IBr) series in *Comaster* [*Neocomatella*] *alata* (*Actinometra pulchella*), but in this case the definitive arms were smaller than the normal arms.

It is suggested that *Promachocrinus* may have been derived from *Heliometra* by a simple division, or doubling, of the radials at an early growth stage, each resultant half of the original radials being of equal vegetative power. The basal rays of the adult *Promachocrinus* lie under one of each of the pairs of radials instead of between the pairs as would naturally be expected, this change in position possibly occurring through a predominence of pressure on one side of the anal plate as the latter is lifted out from between the radials. There is no such torsion in *Decametrocrinus*, and it might be inferred that in the young of species of this genus a plate similar to the radianal occupies all the interradial areas. This occurs in *Thaumatocrinus*, which resembles *Pentametrocrinus* and *Decametrocrinus* in its arm structure, and it may well be that the young of *Pentametrocrinus* and *Decametrocrinus* will be found to be very similar to, or identical with, *Thaumatocrinus*.

The anomalous pinnulation of *Uintacrinus* is explained by assuming the presence of two distichals (IIBr elements) beyond each costal (IBr) axillary of which the outer is not an axillary. The arm of *Uintacrinus* from the costal axillary onward is therefore comparable to the entire arm in *Eudiocrinus*, with the location of the first brachial syzygy between the fourth and fifth brachials of the definitive arm as in the Pentametrocrinidae. Mr. Springer has figured a specimen of *Uintacrinus socialis* in which the second postcostal ossicle is an axillary, and another in which the second postradial ossicle, normally the first (costal) axillary, is not axillary. A third specimen figured by him has the first pinnule on the inside instead of on the outside of the arm, and lacks the first distichal ($IIBr_1$). In the young of *Uintacrinus* the second distichal ($IIBr_2$) has distinctly the appearance of an axillary ossicle.

Mr. Frank Springer had purchased from Mr. Alan Owston of Yokohama the collection of recent crinoids which he had been gradually assembling as a result of the dredging operations of his yacht the *Golden Hind*. The stalked crinoids (*Metacrinus rotundus*) he retained for his own collection, turning over the comatulids to the author by whom they were deposited, in Mr. Springer's name, in the National Museum.

Among the comatulids there was a 5-armed species entirely different in appearance from *Eudiocrinus varians*, *E. japonicus* and *E. tuberculatus* which was at once recognized as being closely related to *Eudiocrinus indivisus* and at the same time related to the Japanese species of *Zygometra*, *Z. hartlaubi*, *Z. rubroflava*, and *Z. koehleri*. So important did this discovery seem at the time that a preliminary note dividing the genus *Eudiocrinus* as understood by Carpenter into two sections, *Eudiocrinus sensu stricto* and *Pentametrocrinus*, was incorporated in a paper then in course of preparation on a further revision of the old genus *Antedon*, which was published on April 11. A more detailed paper dealing with the genus *Eudiocrinus* written at the same time was published on June 20.

In this paper the genus *Eudiocrinus* was carefully analyzed and separated into its component elements, the species *indivisus*, *granulatus* and *variegatus* (sp. nov.) being left in *Eudiocrinus*, s. s., and *atlanticus*, *japonicus*, *semperi*, *tuberculatus*, and *varians* being assigned to *Pentametrocrinus*.

The family Zygometridae was redefined and enlarged to include *Zygometra* and *Eudiocrinus*, and the family Pentametrocrinidae was made to include *Pentametrocrinus*, and *Decametrocrinus*.

Eudiocrinus variegatus, sp. nov., was described in detail, and a cirrus and the pinnules on either side of the base of the arm figured.

The arm structure of the 10-armed comatulids and of the *Eudiocrinus indivisus* and *E. japonicus* groups is described in detail, and that of *E. indivisus* and its allies is shown to be exactly comparable to that of a normal 10-armed comatulid, excepting only that the second postradial ossicle is not axillary; in fact it is duplicated by the structure of the undivided postradial series figured by Carpenter in *Antedon clemens;* while that of *E. japonicus* and its relatives is comparable to the structure of a 10-armed comatulid beyond the costal axillary.

The costals (IBr) are shown to be merely reduplications of the first two brachials interpolated between the base of the free undivided arms and the radials, and evidence that this is the case is found in *Perometra diomedeae* in which an elongated tubercle occurs on the articulation between the elements of each of the pairs, in *Tropiometra* in which the elements of both pairs are greatly and similarly enlarged, and in various species of *Charitometra* and of *Thalassometra* in which the first two brachials and all the pairs of ossicles between them and the radials are similarly ornamented. Division series succeeding the costals are merely repetitions of them, and in division series of 4 (3+4) two pairs of ossicles are present instead of the more usual one.

It happened that one of the radial articular faces of the specimen of *Eudiocrinus variegatus* was exposed through the loss of an entire postradial series This was found to be strikingly similar to the radial articular faces of *Zygometra hartlaubi.* The radial articular faces of *Pentametrocrinus japonicus*, on the other hand, were found to be entirely different and similar to those of *Decametrocrinus*, coming nearest to those of certain genera of the Antedonidae, such as *Thaumatometra* and *Psathyrometra*, and the general character of the pinnules, arms, and cirri also suggests the same relationship.

Figures were given of the radial articular faces of *Pentametrocrinus japonicus* (lateral and ventral views), *Psathyrometra fragilis* (lateral view), and *Zygometra hartlaubi* (lateral and ventral views), of the proximal portion of an arm pair of *Thaumatometra tenuis*, of the proximal portion of the arms of *Pentametrocrinus tuberculatus* and of *Eudiocrinus variegatus*, and of the lower pinnules on both sides of the arm and of a cirrus of the last named.

A detailed account of the Owston collection of comatulids was published on July 15; the species included were:

Comaster robustipinna.
Comaster japonica.
Comaster parvicirra.
Comaster imbricata.
Eudiocrinus variegatus.
Himerometra subcarinata.
Oligometra japonica.
Cyllometra albopurpurea
Thalassometra orion.
Thalassometra quinquecostata.
Thalassometra aster.
Thalassometra komachi.
Charitometra distincta.
Charitometra lata.
Calometra flavopurpurea.
Calometra separata.
Calometra multicolor.
Tropiometra afra.
Perometra diomedeae.
Erythrometra ruber.
Compsometra serrata.
Iridometra psyche.

A supplementary list of the additional crinoids known from Japan is given; these are:

Comatula paucicirra.
Comaster mariae.
Comaster multiradiata.
Comaster serrata.
Comaster solaster.
Catoptometra hartlaubi.
Catoptometra koehleri.
Catoptometra rubroflava.
Himerometra delicatissima.
Himerometra döderleini.
Himerometra stylifer.
Cyllometra tigrina.
Thalassometra alboflava.
Thalassometra diadema.
Thalassometra hana.
Thalassometra latipinna.
Thalassometra pubescens.
Charitometra garrettiana.
Charitometra hepburniana.
Poecilometra acoela.
Calometra callista.
Calometra versicolor.
Asterometra anthus.
Asterometra macropoda.
Nanometra bowersi.
Iridometra adrestine.
Iridometra briseis.
Iridometra minuta.
Thaumatometra alternata.
Thaumatometra parva.
Heliometra clio.
Heliometra laodice.
Heliometra mariae.
Thysanometra tenelloides.
Decametrocrinus borealis.
Pentametrocrinus diomedeae.
Pentametrocrinus japonicus.
Pentametrocrinus tuberculatus.
Pentametrocrinus varians.

and the following stalked species:

Metacrinus angulatus.
Metacrinus rotundus.
Metacrinus superbus.
Carpenterocrinus mollis.
Phrynocrinus nudus.
Bathycrinus pacificus.

All of these species, excepting *Comaster multiradiata*, *Himerometra döderleini*, *Thalassometra latipinna*, *Thaumatometra alternata*, and *Carpenterocrinus mollis* were secured by the *Albatross* in 1906.

The generic name *Catoptometra* is here used for the first time; no diagnosis is given, and the name is merely used in connection with the species *hartlaubi*, *koehleri*, and *rubroflava*, listed in the family Zygometridae.

The new generic name *Carpenterocrinus* is used in combination with (*Pentacrinus*) *mollis* P. H. Carpenter without explanation.

Pentametrocrinus diomedeae is a *nomen nudum*.

Calometra propinqua is not included, being considered a synonym of *C. versicolor*.

Nanometra bowersi as given includes *Antedon minor*, *A. orientalis*, and *Nanometra minckerti*, though none of there are mentioned.

Heliometra hondoensis and *H. rathbuni* are not listed; the former is considered a synonym of *H. mariae*, and the latter a synonym of *H. laodice*.

Himerometra crassipinna is stated to have been seen labeled, probably erroneously, as from Japan.

A card catalogue of all the generic and specific names which had been applied to recent crinoids, with annotations, had been prepared, and this was published on August 25. The new matter included is as follows:

Comatula helianthus, nomen novum, is proposed for *Actinometra elongata* P. H. Carpenter, 1888, not *Comatula elongata* J. Müller, 1849.

Alecto Leach, 1815 (genotype *Alecto horrida*, sp. nov.) is not available as a generic name among the comatulids, being based upon an unrecognizable form.

The type locality of *Antedon abyssicola* P. H. Carpenter, 1888, is determined as *Challenger* Station 244.

Antedon bassett-smithi Bell, 1894, described in the "*Spinifera* group," really belongs in the "*Palmata* group."

Antedon capensis Bell, 1905, described in the "*Basicurva* group," is identical with *Comatula carinata* Lamarck, 1816, placed by P. H. Carpenter in the "*Milberti* group." Some of Bell's original specimens were compared with *carinata* from Mauritius and Zanzibar. *Comatula carinata* from east Africa varies very little, but specimens from the West Indies and Brazil are very variable, expecially in regard to the carination of the arms. Six-rayed individuals also are common in the latter locality.

Antedon eschrichti var. *magellanica* Bell, 1882, is in need of redescription; the characters separating it from *A. rhomboidea* in the *Challenger* report do not hold.

Antedon fieldi Bell, 1894, is not recognizable from the description; it certainly does not belong to the "*Spinifera* group" in which it was described.

Antedon flavomaculata Bell, 1894, is not recognizable from the description; although described in the "*Spinifera* group" this is probably a member of the "*Palmata* group," possibly of the "*Multicolor* group," but certainly not of the "*Spinifera* group."

The type locality of *Antedon gorgonia* de Fréminville, 1811, is determined as Havre, France.

Antedon insignis Bell, 1882 = *A. lovéni* Bell, 1884.

Antedon lovéni Bell, 1882 = *A. pumila* Bell, 1884.

Antedon macrodiscus Hara, 1895, is related to *A. afra* Hartlaub from which, however, it is quite distinct, the length of the lower pinnules being especially remarkable. The author has examined one specimen of each. (This was written before the Owston collection was received.)

Antedon magnicirra Bell, 1905, was described as standing next to *Antedon angustiradia*, that is, as belonging to the "*Savignyi* group"; in reality it belongs to the "*Granulifera* group," falling in the genus *Thalassometra*.

Antedon moorei Bell, 1894, is not recognizable from the published description; it certainly does not belong to the "*Spinifera* group" in which it was described, but is probably a member of the "*Palmata* group."

Antedon sclateri Bell, 1905, was described in the "*Savignyi* group," but is a member of the "*Granulifera* group" closely related to *Charitometra inaequalis*.

Antedon stella A. H. Clark, 1907, is not necessary, for *Antedon tenuis* P. H. Carpenter, 1887, is a *nomen nudum* and therefore does not invalidate *Antedon tenuis* A. H. Clark, 1907.

Antedon vicaria Bell, 1894, is not recognizable from the description; although described in the "*Spinifera* group" it is in reality a member of the "*Palmata* group."

Carpenterocrinus A. H. Clark, 1908, is listed, with the genotype *Pentacrinus mollis* P. H. Carpenter, 1884.

Catoptometra A. H. Clark, 1908, is listed, with the genotype *Antedon hartlaubi* A. H. Clark, 1907.

The type of *Comatula* Lamarck, 1816, is determined as *C. solaris*.

The anomalous figure of *Comatula adeonae* published by de Blainville is identified as a copy of the figure given by Audouin to illustrate his *Comatula multiradiata* from the Red Sea which was later called *savignii* by Müller.

Cyllometra belli A. H. Clark, 1907, is not necessary; *Antedon lovéni* Bell, 1884 (not *A. lovéni* Bell, 1882) for which the name was proposed is the same as *Antedon insignis* Bell, 1882; *Cyllometra belli* therefore becomes a synonym of *Antedon insignis*.

Encrinus Andreae, 1763, is listed with the genotype *E. coralloides*, sp. nov., which appears to be the same as *Pentacrinites fossilis* Blumenbach, 1804.

Himerometra helianthus A. H. Clark, 1907, *nomen nudum*, refers to *H. heliaster* A. H. Clark, 1908.

The genotype of *Metacrinus* P. H. Carpenter, 1882, is determined as *M. wyvillii* P. H. Carpenter, 1884.

In view of the abundance of *Metacrinus superbus* off southwestern Japan it is suggested that the type of this species may have come from somewhere in the Japanese region.

Pentacrinus balfouri Wyville Thomson, MS. = *P. naresianus* P. H. Carpenter, 1882.

The type of *Pterocrinus* P. H. Carpenter, 1884, is determined as *Bathycrinus australis* A. H. Clark, 1907.

The results of a study of the axial canals in *Isocrinus decorus*, *Endoxocrinus parrae* and *Metacrinus rotundus* were published on October 30.

Fifteen specimens of *Isocrinus decorus* were dissected, and infrabasals were found in every case. Five specimens of *Metacrinus rotundus* and one of *M. superbus* were dissected, and infrabasals were found in all six. Three specimens of *Endoxocrinus parrae* were dissected, and in all three infrabasals were absent. So far as can be judged from Carpenter's figures they are also absent in *E. wyvillethomsoni* and *E. alternicirrus*. It is possible, therefore, that *Endoxocrinus* constantly differs from *Isocrinus* and *Metacrinus* in the absence (through resorption when very young) of the infrabasals. This was suggested in the original diagnosis of the genus *Endoxocrinus* published on June 9.

The species of which the axial canals were described and figured by Reichensperger is shown to be *Endoxocrinus parrae* instead of *Isocrinus decorus*.

The column of a very young *Isocrinus decorus* is described and figured. The columnals are bourgueticrinoid in character and the articular faces consist of two ligament fossae separated by a median fulcral ridge running along the longer axis of the oval joint face.

In a paper published on October 30 the homologies of the postradial ossicles in the recent comatulids and pentacrinites and in *Uintacrinus* are discussed in great detail. The brachial articulations are minutely described and are divided into two types, *muscular*, with two subdivisions, *straight* and *oblique*, and *nonmuscular*, also with two subdivisions, *synarthries* and *syzygies*. The ossicles of the division series, no matter how many of them there may be, are shown to be repetitions of the first two brachials at the base of the free undivided arms interpolated between the base of the arms and the radials, excepting in a very few anomalous types This pair of brachials is designated as the Z pair and is assumed to consist of the two components Z_1 and Z_2. Division series composed of simple repetitions of the Z pair interpolated between the original Z pair and the radials are called *interpolated* division series, while division series formed by a splitting of the arm at a certain ossicle which thereby becomes an axillary are called *extraneous* division series. The conclusions reached in this paper have for the most part been forecast in preceding papers.

The anomalous arm structure of *Comaster mariae*, *C. fimbriata*, *C. coppingeri*, *C. borneensis*, *C. multiradiata*, *C. iowensis*, *C. sentosa*, *C. lineata*, and *C. discoidea* is explained by assuming that in these the Z pair is represented by the two segments immediately following the costal (IBr) axillary and that all the division series beyond the costals (IBr) are extraneous.

On the basis of the type of arm division the comasterids are distributed among three genera, as follows:

Comatula (genotype *C. solaris* Lamarck, 1816) including—

Comatula distincta.
Comatula multibrachiata.
Comatula notata.
Comatula paucicirra.
Comatula pectinata.
Comatula solaris.

Phanogenia (genotype *P. typica* Lovén, 1866), including—

Phanogenia alata.
Phanogenia alternans.
Phanogenia belli.
Phanogenia bennetti.
Phanogenia briareus.
Phanogenia carpenteri.
Phanogenia divaricata.
Phanogenia duplex.
Phanogenia echinoptera.
Phanogenia elongata.
Phanogenia gracilis.
Phanogenia grandicalyx.
Phanogenia japonica.
Phanogenia meridionalis.
Phanogenia littoralis.
Phanogenia macrobrachius.
Phanogenia maculata.
Phanogenia magnifica.
Phanogenia nobilis.
Phanogenia novae-guineae.
Phanogenia orientalis.
Phanogenia parvicirra.
Phanogenia peronii.
Phanogenia quadrata.
Phanogenia regalis.
Phanogenia robustipinna.
Phanogenia rotalaria.
Phanogenia rubiginosa.
Phanogenia schlegelii.
Phanogenia serrata.
Phanogenia solaster.
Phanogenia stelligera.
Phanogenia trichoptera.
Phanogenia typica.
Phanogenia valida.
Phanogenia variabilis.

Comaster (genotype *Comatula multiradiata* Lamarck, 1816 = *Asterias multiradiata* Linné) including—

Comaster borneensis.
Comaster coppingeri.
Comaster discoidea.
Comaster fimbriata.
Comaster mariae.
Comaster multiradiata.
Comaster sentosa.
Comaster iowensis.
Comaster lineata.

Comatula as here understood is characterized by having all the synarthries replaced by syzygies.

In *Phanogenia* synarthries are present between the first two post-radial ossicles and all the arm divisions are of the interpolated type.

In *Comaster* synarthries are likewise present between the first two post-radial ossicles, and the first arm division is interpolated, while those following are all extraneous.

In *Isocrinus naresianus* and in the species of *Endoxocrinus* the arm division is interpolated as in most of the comatulids. In *Isocrinus decorus* and in *I. blakei* the Z pair always remains the first two ossicles beyond the costal axillary and the further arm branching is extraneous. In *Metacrinus* the Z pair, as in the Pentametrocrinidae, consists of the first two ossicles following the radials.

The recent pentacrinites are distributed in four genera as follows:

Metacrinus (genotype *M. wyvillii* P. H. Carpenter, 1884); Z_1 and Z_2 the first two post-radial ossicles, not repeated; all arm division extraneous; second post-radial ossicle not an axillary, but bearing a pinnule; basals very broad, forming, when viewed dorsally, a rounded pentagonal figure; infrabasals large and prominent (found in *M. serratus* by Döderlein and in *M. superbus* and in several specimens [all dissected] of *M. rotundus* by the author). The included species are:

Metacrinus acutus.
Metacrinus angulatus.
Metacrinus cingulatus.
Metacrinus costatus.
Metacrinus moseleyi.
Metacrinus murrayi.
Metacrinus murrayi nobilis.
Metacrinus murrayi timorensis
Metacrinus nodosus.
Metacrinus rotundus.
Metacrinus rotundus interruptus.
Metacrinus serratus.
Metacrinus stewarti.
Metacrinus suluensis.
Metacrinus superbus.
Metacrinus superbus borealis.
Metacrinus superbus tuberculatus.
Metacrinus tuberosus.
Metacrinus varians.
Metacrinus wyvillii.

Hypalocrinus (genotype *Pentacrinus naresianus* P. H. Carpenter, 1882); Z_1 and Z_2 repeated at least once; the second postradial joint an axillary; Z_1 and Z_2 the third and fourth postradial ossicles; infrabasals ?; one interpolated series only; basals broad, forming, when viewed dorsally, a rounded pentagonal figure. The included species is:

Hypalocrinus naresianus

Isocrinus (genotype *Isocrinus pendulus* von Meyer, 1837); differs from *Hypalocrinus* in having one interpolated series, followed by one or more extraneous series; basals narrow, forming, in dorsal view, a rounded stellate figure; infrabasals large and prominent (determined from an examination of 15 specimens of *I. decorus*, including a very small 10-armed individual with arms 25 mm. long; material of other species was not available).

Two subgenera are recognized, *Cenocrinus*, in which the first two postradial ossicles are united by syzygy, the lower pinnules are serrate, and the reëntrant angles of the stellate figure formed by the basals shallow, and *Isocrinus*, in which the first two postradial ossicles are united by synarthry, the lower pinnules are smooth, and the reëntrant angles of the stellate figure formed by the basals deep.

The species of *Isocrinus* are:

Isocrinus (*Cenocrinus*) *asteria*.
Isocrinus (*Isocrinus*) *blakei*.
Isocrinus (*Isocrinus*) *decorus*.

Endoxocrinus (genotype *Encrinus parrae* Gervais, 1835 [=*Pentacrinus mülleri* Örsted, 1856]): Z_1 and Z_2 are the first and second ossicles of the free undivided arm and are separated from the radials by two or more interpolated series; infrabasals always (?) absent (infrabasals were absent in all the specimens dissected, including one with arms only 25 mm. long). The included species are:

Endoxocrinus alternicirrus.
Endoxocrinus parrae.
Endoxocrinus sibogae.
Endoxocrinus wyville-thomsoni.

Pentacrinus maclearanus Wyville Thomson is stated to be merely a rather strongly marked variety of *Endoxocrinus parrae*.

Two new names are used; *Metacrinus superbus borealis* is said to differ from the typical form mainly in having the division series and arm bases smooth instead of very rough; *Metacrinus superbus tuberculatus* is said to have the division series with strong tubercles, but otherwise resembling the preceding. Although not so stated, both these supposed varieties are from the Eastern Sea off Kagoshima.

Just over a year after I described the genus *Ptilocrinus* and the type species *Pt. pinnatus*, Dr. F. A. Bather described a second species of the genus, *Pt. antarcticus*, which had been dredged by the Belgian Antarctic Expedition in 480 meters in the region south of Cape Horn. In a review of this paper published on July 31 the distribution of the crinoids as a whole was discussed.

Three faunal regions were recognized, as follows:

(1) The Indo-Pacific-Japanese, characterized by the families Zygometridae and Himerometridae, the genera *Comatula*, *Phanogenia*, and most of the species of *Comaster*, in the Comasteridae, the genera *Ptilometra*, *Asterometra*, *Calometra*, and one of the two species of *Tropiometra* (the second species, *T. carinata*, appears to have recently extended its range into the Atlantic) of the Tropiometridae, and the genera *Perometra*, *Nanometra*, *Compsometra*, *Thysanometra*, and *Iridometra* of the Antedonidae; among the stalked crinoids *Metacrinus*, *Carpenterocrinus*, *Hypalocrinus*, and *Phrynocrinus* are only known from this region.

(2) The Polar-Pacific, including the Arctic and Antarctic circumpolar areas, and the entire American coast of the Pacific from Bering Straits to the Straits of Magellan, the coasts of eastern Asia to southern Japan (where it meets the preceding at Tokyo Bay), including the Sea of Okhotsk and the Sea of Japan, and the Atlantic coasts south to near the Hebrides and the Faroe Channel, and to the Gulf of Maine, characterized by various genera belonging exclusively to the Antedonidae, *Heliometra* occurring everywhere, *Hathrometra* confined to the north, and *Isometra* to the south, while *Thaumatometra* occurs in the south but extends northward in the Pacific to the Aleutian Islands; among the stalked crinoids the *Bathycrinus carpenterii* type (*B. carpenterii*, *B. complanatus*, and *B. australis*) appear possibly to be peculiar to the region; bathymetrically the characteristic forms (except *Bathycrinus*) are inhabitants of comparatively shallow water in both polar areas, but dip downward to a considerable depth when passing under the tropics.

(3) The Oceanic, which occurs everywhere in moderate to very deep water with the Indo-Pacific-Japanese and extends thence over the entire ocean area except that it does not intrude into the area occupied by the Polar-Pacific; the characteristic forms are the species of *Thalassometra* having rounded and spiny rays and arm bases (such as *T. bispinosa*, *T. villosa*, *T. gigantea*, *T. pubescens*, *T. multispina*, and *T. aster*) and certain other species, such as *T. flava*, *T. porrecta*, and *T. magnicirra*, *Stylometra*, *Bathymetra* and *Charitometra*, except the *aculeata*, *hepburniana*, *basicurva*, and *tuberosa* groups; of stalked crinoids, *Rhizocrinus*, *Endoxocrinus*, and the species of *Bathycrinus*, except the *B. carpenterii* group, belong here.

It is stated that the West Indian fauna falls almost wholly in the last division, but there is a trace of Indo-Pacific-Japanese influence, as, however, we might expect, since the entire Oceanic fauna is a direct, though considerably modified, derivation from it, even the well-known subgenera of Pentacrinitidae *Encrinus* (the subgenus *Cenocrinus* of Wyville Thomson; see beyond) and *Isocrinus* being only a comparatively slight advance over the apparently more primitive *Metacrinus* type.

The Mediterranean-northeast Atlantic fauna, characterized by *Antedon* (*A. mediterranea*, *A. bifida*, and *A. petasus*) and *Leptometra*, appears to be a localized offshoot from the Polar-Pacific fauna.

It is pointed out that while *Heliometra* occurs throughout the Polar-Pacific area the two Arctic species, *glacialis* (=*eschrichtii*) and *quadrata* (with their representatives in the Sea of Okhotsk, *maxima* and *brachymera*) differ from the Antarctic and east Pacific species in the smoothness of their arms and in a different distribution of the brachial syzygia.

In a paper published in November various questions converning the ecology of the recent crinoids are considered.

In very shallow water *Antedon bifida* is usually about 120 mm. in expanse, while individuals from deep water are 220 mm. or more across. This is explained by supposing that throughout the range of this species the very small pelagic organisms and minute crustaceans which serve as food are when living more or less evenly distributed, but with increasing depth the supply of dead falling to the bottom increases in intensity, resulting in a progressively greater food supply.

In general the size of crinoids gradually increases to 100 fathoms, from 100 to about 600 fathoms remaining uniform, and below 600 fathoms gradually decreasing to the greatest depths, where only very small species are found. Below 100 fathoms plant life disappears, but this disappearance is offset by the gradual increase in the rain of carcasses from above, so that an equilibrium is obtained down to about 600 fathoms; below 600 fathoms gradual decomposition of the carcasses lessens the food value and we find the crinoids decreasing in size. It is pointed out that the pentacrinites, which are remarkably uniform in size when compared with the comatulids, are almost exclusively confined to the 100–600 fathom belt; the two species which descend to below 1,000 fathoms are both small.

The unusually large size of *Heliometra glacialis* in certain localities is explained as follows: On the west coast of Greenland, by the fresh-water ice which by melting kills millions of small organisms, which fall to the bottom and serve as crinoid food: about Spitzbergen by the fresh water from the snow and ice on the land which acts in the same way; on the Grand Banks by the mingling of the warm Gulf Stream and the cold northern water, by which organisms in both are killed; in the Sea of Japan by the mingling of the warm tropical and cold northern water; here areas of warm bottom water are dovetailed in with areas of cold and the size of the crinoids in both is similarly increased.

The occurrence of pentacrinites in shallow water off Cuba, Guadeloupe, and southern Japan is explained by the existence of fresh water streams the water from which kills the plankton but does not penetrate deeply enough to injure the crinoids.

In the East Indies very large species of comatulids occur abundantly in very shallow water, often just below low tide mark, and these decrease in size with depth. This is explained by the killing of the plankton in the littoral water by the action of the sun's heat and by rain, the dead organisms being deposited just beyond the low tide mark. It is pointed out that the large littoral species occur only where the rainfall is abundant.

The comatulids with large eggs, termed "Antedonoida," have a relatively restricted distribution; the large eggs are assumed to develop rapidly, implying a relatively short duration of the active free-swimming stage and consequent inability to travel widely. The species with small eggs, included in the Thalassometroida (in which group *Thalassometra*, *Charitometra*, and *Tropiometra* are mentioned), have a relatively large range; the assumed longer duration of the free-swimming period results in greater facilities for dispersal and the assumed slower development of the larva possibly a greater power of adaptation.

The coloration of the recent crinoids in life is considered in detail. All colors are found in the crinoids except blue, though true black is confined to the disks of the species of Pentametrocrinidae and to lines and spots on two species of *Coccometra*. Yellow is the commonest color in the group, and is the color of all the more primitive forms and of the young of almost all the others; it may, therefore, be taken as the basic crinoid color. The pentacrinoids of *Antedon bifida* are sometimes pink, though usually, like the pentacrinoids of the other forms in which they are known, yellow, and certain other types are dull pinkish in all stages. Two basic colors are therefore assumed, yellow and red, the latter an intensification of the former and found generally in the more specialized forms.

The derivatives from these two basic colors as they occur in the crinoids are grouped as follows:

$$\text{I. Yellow}\text{-------}\left\{\begin{array}{l} +[\text{Blue}] = \left\{\begin{array}{l}\text{White.}\\ \text{Green.}\end{array}\right. \\ +[\text{Black}] = \text{Brown.}\end{array}\right.$$

$$\text{II. Red}\text{ ---------}\left\{\begin{array}{l} +[\text{Blue}] = \left\{\begin{array}{l}\text{Purple; maroon.}\\ \text{Violet.}\end{array}\right. \\ +[\text{Black}] = \text{Crimson.}\end{array}\right.$$

No species is known which exhibits a perfect blending of these two basic types or their derivatives, though there are many mosaics in which both are found side by side, either in different individuals or, more commonly, in the form of a color pattern made up partly from one base and partly from the other, each being clearly defined, in the same individual.

It is stated that the data seem to show that the smaller stalked forms are invariably and unchangeably yellow, which color may be, as in the case of the parrots among birds, equivalent to a lack of color. Black is added to the basic color of comatulids at all depths and appears to denote age. Blue is added apparently only within 200 fathoms of the surface, and increases in intensity to the surface. The mosaics are all littoral or shallow water types.

Species growing among coral or on white bottom in shallow water are very dark in color, often nearly black or sharply black and white, while the same species on mud may be light yellow and pinkish. Thus there seems to be a close connection between color and amount of illumination, the blue factor in the coloration increasing with the light.

There appears to be no direct relation between the color of crinoids and their environment. The yellow deep water species are very conspicuous in the mud from a deep dredge haul, while the color of shallow water species is commonly in great contrast to their surroundings.

It is suggested that the other echinoderms appear to be in general subject to the same laws of color change as the crinoids.

Through the kindness and courtesy of Dr. Th. Mortensen, the large and exceedingly interesting collection of the Zoological Museum of Copenhagen had been sent to me. Aside from its great intrinsic and historical value the collection was of the greatest importance to me for the reason that it contained representatives of many of the Indo-Pacific types which previously I had only known through often quite inadequate descriptions and figures.

On December 10 a preliminary paper was published, including descriptions of the new species in this collection. These were:

Comanthus intricata (Lütken, MS.).
Comanthus decameros.
Himerometra grandis.
Himerometra molleri (Lütken, MS.).
Himerometra schlegelii (Lütken, MS.).
Himerometra producta.
Himerometra ensifer.
Cyllometra anomala.
Oligometra pulchella.
Oligometra imbricata.
Asterometra lepida.
Mastigometra flagellifera (Lütken, MS.).
Heliometra glacialis biarticulata.

Comanthus intricata, sp. nov. = *Actinometra intricata* Lütken, MS., not *Actinometra intricata* Lütken, 1874 = *Comatula rotalaria* Lamarck, 1816 = *Alecto parvicirra* J. Müller, 1841.

With the specimens of *Oligometra imbricata* was found the name *Antedon cupuliferus* Lütken, MS.

The new genus *Mastigometra* was described, and the new generic name *Comanthus* appears, under which, in combination, two new species, *intricata* and *decameros*, are described.

The first shipment of crinoids from the work of the *Albatross* in the Philippine Islands had arrived, and on December 23 a preliminary notice of the species included was published.

The new species described were:

Metacrinus zonatus.
Catoptometra magnifica.
Eudiocrinus serripinna.
Himerometra bartschi.
Himerometra robustipinna.
Himerometra magnipinna.
Himerometra discoidea.
Himerometra unicornis.
Himerometra echinus.
Himerometra gracilipes.
Cyllometra suavis.
Oligometra gracilicirra.
Calometra carduum.
Calometra acanthaster.
Ptilometra trichopoda.
Charitometra smithi.
Perometra elongata.
Eumetra chamberlaini.
Iridometra scita.
Trichometra explicata.
Pentametrocrinus diomedeae.

The new genera included were:

Comanthus.
Comatella.
Eumetra.

The new genus *Comanthus* (genotype *Alecto parvicirra* J. Müller) was diagnosed as follows: First articulation of the free arm a synarthry; all division series 4(3+4) or 2; terminal comb long, with short teeth, continuing in the same direction as the basal portion of the pinnule, and confined to the pinnules in the proximal part of the arm. This is contrasted with *Phanogenia* as restricted, which is rediagnosed as follows: First articulation of the free arm a syzygy; all division series except the first 2(1+2); terminal comb short, with long curved teeth, and set at an angle to the axis of the pinnules, not confined to the proximal pinnules, but occurring at intervals throughout the arm. *Comatula* is said to be readily distinguishable from both by the syzygy between the costals, and *Comaster* by the presence of a pinnule on the first brachial of all arms not arising from costal axillaries.

The previously described species recorded were:

Comaster sentosa.
Comaster fimbriata.
Comaster coppingeri.
Comatula pectinata.
Phanogenia typica.
Phanogenia novae-guineae.
Phanogenia multibrachiata.
Comanthus nobilis.
Comanthus duplex.
Comanthus divaricata.
Comanthus rotalaria.
Comanthus alternans.

Comanthus cumingii.
Comatella nigra.
Zygometra elegans.
Pontiometra andersoni.
Himerometra persica.
Himerometra bengalensis.
Himerometra quinduplicava.
Himerometra anceps.
Himerometra milberti.
Himerometra variipinna.
Himerometra protectus.
Himerometra monacantha.
Cyllometra manca.
Oligometra pulchella.
Thalassometra compressa.

Another paper published in December is essentially a composite of the paper based upon a review of Bather's description of *Ptilocrinus antarcticus* and that on the ecology of the recent crinoids.

It had been evident for some time that the status of the families Himerometridae and Thalassometridae was unsatisfactory, and on January 9, 1909, a revision of both these families was published, with keys to all the included genera.

It was stated that although the new genera described are based upon obvious external characters in order that they may be readily recognized and identified from ordinary museum material, in many cases, as with the larger divisions, the best characters are found in the musculature studied from the point of view of skeletal muscle insertions, and in the internal structure of the centrodorsal.

The Thalassometridae was found to include two well-defined groups; in one the cirri are short, stout, and smooth, and P_1 is slender and composed of very short segments, while in the other the cirri are long, comparatively slender, and spinous, and P_1 is stout and composed of enlarged segments. The cirri of the latter morphologically differ from those of the former in the distal addition of numerous segments bearing dorsal spines, and the line of demarcation between these two types of segments is commonly marked by a so-called "transition segment" representing the penultimate segment in the cirri of the short smooth type. The increased cirrus length is correlated, as is commonly the case in the comatulids, with an increase in the size of the lower pinnules.

The species of the Himerometridae are distributed among 11 genera, of which 7 are new; these genera, with the included species, are:

Pontiometra, including

Pontiometra andersoni.

Colobometra, gen. nov. (genotype *Antedon perspinosa* P. H. Carpenter, 1881), including

Colobometra perspinosa.
Colobometra suavis.

Cyllometra, including

Cyllometra albopurpurea.
Cyllometra anomala.
Cyllometra clarae.
Cyllometra impinnata.
Cyllometra informis.
Cyllometra manca.
Cyllometra tigrina.

Amphimetra, gen. nov. (genotype *Comatula* [*Alecto*] *milberti* J. Müller, 1846), including

Amphimetra anceps.
Amphimetra ensiformis.
Amphimetra laevissima.
Amphimetra milberti.
Amphimetra molleri.
Amphimetra producta.
Amphimetra schlegelii.
?Amphimetra tessellata.
Amphimetra variipinna.

Himerometra, including

Himerometra bartschi.
Himerometra crassipinna.
Himerometra kraepelini.
Himerometra magnipinna.
Himerometra martensi.
Himerometra persica.
Himerometra robustipinna.
Himerometra philiberti.

Oligometra, including

Oligometra adeonae.
Oligometra bidens.
Oligometra caribbea.
Oligometra carpenteri.
Oligometra gracilicirra.
Oligometra imbricata.
Oligometra japonica.
Oligometra pinniformis.
Oligometra pulchella.
Oligometra serripinna.

Cenometra, gen. nov. (genotype *Himerometra unicornis* A. H. Clark, 1908), including

Cenometra abbotti.
Cenometra bella.
Cenometra brunnea.
Cenometra unicornis.

Craspedometra, gen. nov. (genotype *Antedon acuticirra* P. H. Carpenter, 1882), including

Craspedometra acuticirra.
Craspedometra australis.
Craspedometra bipartipinna.
Craspedometra ludovici.

Stephanometra, gen. nov. (genotype *Antedon monacantha* Hartlaub, 1890), including

Stephanometra acuta.
Stephanometra echinus.
Stephanometra indica.
Stephanometra monacantha.
Stephanometra oxyacantha.
Stephanometra spicata.
Stephanometra spinipinna.
Stephanometra tenuipinna.
Stephanometra tuberculata.

Heterometra, gen. nov. (genotype *Antedon quinduplicava* P. H. Carpenter, 1888), including

Heterometra affinis.
Heterometra bengalensis.
Heterometra brockii.
Heterometra quinduplicava.
Heterometra reynaudi.
Heterometra savignii.

Dichrometra, gen. nov. (genotype *Alecto flagellata* J. Müller, 1841), including

Dichrometra articulata.
Dichrometra bimaculata.
Dichrometra brevicuneata.
Dichrometra elongata.
Dichrometra flagellata.
Dichrometra gracilipes.
Dichrometra grandis.
Dichrometra gyges.
Dichrometra heliaster.
Dichrometra klunzingeri.
Dichrometra marginata.
Dichrometra occulta.
Dichrometra okelli.
Dichrometra palmata.
Dichrometra protectus.
Dichrometra regalis.
Dichrometra reginae.
Dichrometra subcarinata.
Dichrometra subtilis.
Dichrometra tenera.

Two species are unplaced: *Antedon finschii* Hartlaub, which appears to be most closely related to *Pontiometra andersoni* and possibly congeneric with it, and *Antedon erinacea* Hartlaub, which appears to represent a distinct generic type for which the name *Oxymetra* is suggested.

The family Thalassometridae is divided into the subfamilies Thalassometrinae and Charitometrinae. The following genera and species are assigned to the Thalassometrinae:

Stylometra, including

Stylometra spinifera.
Stylometra, sp.

Thalassometra, including

Thalassometra agassizii.
Thalassometra aster.
Thalassometra bispinosa.
Thalassometra echinata.
Thalassometra gigantea.
Thalassometra hawaiiensis.
Thalassometra multispina.
Thalassometra pergracilis.
Thalassometra pubescens.
Thalassometra villosa.

Stenometra, gen. nov. (genotype *Antedon quinquescostata* P. H. Carpenter, 1888), including

Stenometra conifera.
Stenometra diadema.
Stenometra hana.
Stenometra quinquecostata.

Stiremetra, gen. nov. (genotype *Antedon acutiradia* P. H. Carpenter, 1888), including

Stiremetra acutiradia.
Stiremetra breviradia.
Stiremetra spinicirra.

Parametra, gen. nov. (genotype *Antedon orion* A. H. Clark, 1907), including

Parametra compressa.
Parametra fisheri.
Parametra orion.

Cosmiometra, gen. nov. (genotype *Thalassometra komachi* A. H. Clark, 1908), including

Cosmiometra crassicirra.
Cosmiometra delicata.
Cosmiometra komachi.
Cosmiometra woodmasoni.

The following species are unplaced:

Antedon duplex.
Antedon flava.
Antedon incerta.
Antedon latipinna.
Antedon lusitanica.
Antedon magnicirra.
Antedon porrecta.
Antedon valida.

The possibility that the recently described *Antedon adriani* Bell is a member of this subfamily is mentioned, though it is stated that there are grounds for believing it to be a member of the Tropiometridae.

The following genera and species are assigned to the Charitometrinae:

Poecilometra, including

Poecilometra acoela.
Poecilometra scalaris.

Glyptometra, gen. nov. (genotype *Antedon tuberosa* P. H. Carpenter, 1888), including

Glyptometra lata.
Glyptometra lateralis.
Glyptometra tuberosa.

Strotometra, gen. nov. (genotype *Antedon hepburniana* A. H. Clark, 1907), including

Strotometra hepburniana.
Strotometra parvipinna.

Charitometra, including

Charitometra basicurva.
Charitometra incisa.

Pachylometra, gen. nov. (genotype *Antedon distincta* P. H. Carpenter, 1888), including

Pachylometra angusticalyx.
Pachylometra distincta.
Pachylometra flexilis.
Pachylometra inaequalis.
Pachylometra patula.
Pachylometra robusta.
Pachylometra sclateri.
Pachylometra smithi.

Chlorometra, subgen. nov. (genotype *Antedon garrettiana* A. H. Clark, 1907), including

Chlorometra aculeata.
Chlorometra garrettiana.

Crinometra, subgen. nov. (genotype *Comatula brevipinna* Pourtalès, 1868), including

Pachylometra brevipinna.
Pachylometra imbricata.

Through the courtesy of Drs. W. Weltner and R. Hartmeyer, of the Berlin Museum, and of Prof. Th. Studer, of Berne, the crinoids collected in Australian waters by the German steamship *Gazelle* had been sent to me, and on March 10 I published the descriptions of the two new species included; these were:

Ptilometra dorcadis.
Oligometra studeri.

The type of *Ptilometra macronema* was taken at King George's Haven in southwestern Australia, while all the specimens which I had been able to examine were from the eastern coast, mostly from Port Jackson or Sydney. There was a possibility, therefore, that *Pt. dorcadis* might turn out to be the true *macronema,* in which event the name *mülleri* was suggested for the species from Sydney.

In another paper published in March the status of the genus *Encrinus* is considered. *Encrinus* is said to date from Blumenbach, 1779, who included in it three species:

1. *asteria* (*Isis asteria* Linné).
2. *mylii* (or *radiatus*) (type of *Umbellularia* Lamarck, 1801).
3. *boltenii* (or *ouifer*) (type of *Boltenia* Savigny, 1816).

This leaves *asteria* (*Isis asteria* Linné = *Isocrinus asteria*) as the genotype of *Encrinus.*

The recent species are listed as follows:

Encrinus (Encrinus) asteria.
Encrinus (Isocrinus) blakei.
Encrinus (Isocrinus) decorus.

At the suggestion of Dr. F. A. Bather, the Indian Museum, through Dr. N. Annandale, had entrusted to me for study the magnificent collection of recent crinoids which had been brought together as a result of the operations of the Royal Indian Marine Surveying steamer *Investigator.* On April 17 a paper was published containing preliminary descriptions of a number of the new species included in it. These were:

Eudiocrinus minor.
Dichrometra aranea.
Cyllometra mollis.
Calometra magnifica.
Calometra spinosissima.
Crotalometra rustica.
Pachylometra macilenta.
Pachylometra investigatoris.
Eumetra indica.
Metacrinus batheri.

The generic name *Crotalometra,* used in combination with (*Crotalometra*) *rustica* in the description of that species, is new. *Eudiocrinus ornatus,* with which *E. minor* is compared, is a *nomen nudum.*

On the same date a note was published in which a misconception in regard to the type species of Agassiz' genus *Comaster* was rectified. The type of *Comaster* was *Comatula multiradiata* Lamarck, 1816. This species was redescribed by Müller in 1841 from notes made on one of Lamarck's specimens as *Alecto multifida.* Consequently the type of *Comaster* L. Agassiz, 1836, is *Alecto multifida* J. Müller, 1841 = *Comatula multiradiata* Lamarck, 1816, not *Asterias multiradiata* Linné, 1758.

Comaster therefore supplants *Phanogenia* as previously used by me, and for the genus which I had called *Comaster* the name *Capillaster* is proposed with *Actinometra sentosa* P. H. Carpenter, 1888, as the type.

In another note the capture of a small *Iridometra nana*, which had been attracted to and was swimming about a submerged electric light, was recorded, and in a third *Oligometra studeri* is shown to be in reality a species of the genus *Cyllometra*, closely related to *C. informis*.

Among the collections stored in the National Museum I had found some very extraordinary comasterids with a central mouth, covering plates along the ambulacral grooves, sacculi, and deficient pinnulation, which were described in great detail on April 27 under the name of *Comatilia iridometriformis*. A very young specimen showing five large orals and five large interradials lying on the closed radial circlet was described and its affinities discussed at considerable length.

A second consignment of crinoids from the Philippines was recorded on May 13. The new species described were:

Phanogenia minima.
Phanogenia delicata.
Comanthus polycnemis.
Pontiometra insperatus.
Cenometra delicata.
Ptilometra pulcherrima.
Stenometra arachnoides.
Crotalometra eupedata.
Pachylometra levigata.
Iridometra exquisita.

The previously known species included are:

Comaster sentosa.
Comaster multiradiata.
Phanogenia multibrachiata.
Phanogenia carpenteri.
Comatula pectinata.
Comatella nigra.
Comanthus nobilis.
Comanthus briareus.
Comanthus duplex.
Comanthus rotalaria.
Comanthus alternans.
Cenometra unicornis.
Stephanometra tenuipinna.
Cyllometra manca.
Oligometra pulchella.
Calometra carduum.
Parametra compressa.
Glyptometra tuberosa.
Endoxocrinus alternicirrus.
Hypalocrinus naresianus.
Metacrinus wyvillii.

Antedon bassett-smithi Bell, 1894, described in the "*Spinifera* group" of *Antedon* is identified as *Actinometra* (*Comatella*) *stelligera* P. H. Carpenter, 1888. *Comatula fimbriata*, *Actinometra borneensis* and *Actinometra coppingeri* are placed in the synonymy of *Asterias* (*Comaster*) *multiradiata* Linné. Bell's *Actinometra variabilis*, placed by P. H. Carpenter in the "*Parvicirra* group" of *Actinometra*, is in reality closely related to *Phanogenia typica*.

A new genus *Crotalometra* (genotype *Crotalometra eupedata*, sp. nov.) is described, to which are assigned *Antedon valida* P. H. Carpenter, *A. incerta* P. H. Carpenter, and *A. magnicirra* Bell.

The infrabasals of *Hypalocrinus naresianus* are described and figured.

The full report on the comatulids of the *Gazelle* expedition was published on June 1. In this report the fauna of all the coasts of Australia is said to be purely tropical, reaching its minimum intensity along the southern shore and not extending to Tasmania nor New Zealand so far as known. The species recorded are:

Capillaster multiradiata (including *Comatula fimbriata*, *Actinometra borneensis*, and *Actinometra coppingeri*).
Comanthus briareus (including *Actinometra divaricata*).
Comaster typica.
Comanthus rotalaria.
Zygometra microdiscus.
Zygometra elegans.
Dichrometra protectus.
Dichrometra palmata.
Cyllometra, sp.
Cyllometra studeri.
Oligometra bidens.
Ptilometra dorcadis.

The curious disk of the specimen of *Capillaster multiradiata*, which has extensive subtegminal cavities, is described.

Carpenter considered his *Antedon fluctuans* a synonym of Bell's previously described *Antedon elegans*, which was misunderstood by him on account of an error in the original description. Exception is here taken to this view; on the basis of a large series of specimens from Singapore and the Philippine Islands determined as *fluctuans*, this form is considered as quite distinct, and the differential characters are given.

A complete bibliography of the literature on Australian crinoids is appended.

The previous revisions of the family Comasteridae had not proved satisfactory, and on June 7 another and far more radical revision was published in which the included species were distributed among 11 genera, of which 5 were new. Keys to all the genera are included, the new genera are described in detail, the genotype and the range of all the genera are given, and three new species, the types of new genera, are described. The genera accepted are:

Comatilia (genotype *Comatilia iridometriformis* A. H. Clark, 1909).
Comatula (genotype *Comatula solaris* Lamarck, 1816).
Cominia, gen. nov. (genotype *Comanthus decameros* A. H. Clark, 1908).
Comactinia, gen. nov. (genotype *Alecto echinoptera* J. Müller, 1841).
Leptonemaster, gen. nov. (genotype *Leptonemaster venustus*, sp. n.).
Comissia, gen. nov. (genotype *Comissia lütkeni*, sp. nov. = *Comaster coppingeri* A. H. Clark, 1908 [not of Bell], in part).
Capillaster (genotype *Actinometra sentosa* P. H. Carpenter, 1888).
Nemaster, gen. nov. (genotype *Nemaster grandis*, sp. nov.).
Comatella (genotype *Actinometra nigra* P. H. Carpenter, 1888).
Comaster (genotype *Comatula multiradiata* Lamarck, 1816 = *Alecto multifida* J. Müller, 1841).
Comanthus (genotype *Comanthus intricata* A. H. Clark, 1908).

It is suggested that the *Comanthus rotalaria* ("*Actinometra parvicirra*") recorded by P. H. Carpenter from "Peru" may have come from Peru or Francis Island in the Gilbert group instead of from the South American country of that name.

On June 19 descriptions of 17 new species of crinoids were published; five of these were from the *Albatross* West Indian collections, and the remaining twelve were from the collections of the *Investigator* in the Indian Ocean. These new species were:

Eudiocrinus ornatus.
Amphimetra mortenseni.
Heterometra compta.
Heterometra singularis.
Stephanometra coronata.
Colobometra discolor.
Cyllometra taprobanes.
Crotalometra annandalei.
Crinometra pulchra.
Crinometra margaritacea.
Crinometra concinna.
Crinometra insculpta.
Crinometra gemmata.
Psathyrometra mira.
Mastigometra micropoda.
Hypalocrinus springeri.
Hypalocrinus ornatus.

On the same date four new species of *Rhizocrinus* were described, the history of the genus was traced in detail, and the included species were tentatively segregated in three groups. The new species were:

Rhizocrinus conifer.
Rhizocrinus brevis.
Rhizocrinus sabae.
Rhizocrinus robustus.

The three groups were characterized as follows:

1. Basals anchylosed, without sutures (*R. lofotensis; R. verrilli*).

2. Basals always separated by distinct sutures; stem comparatively slender, the longer columnals being at least twice as long as broad; calyx distinctly conical (*R. conifer; R. brevis; R. robustus; R. chuni*).

3. Basals always separated by distinct sutures; stem very stout, the longer columnals being but little longer than broad; calyx approaching the cylindrical (*R. rawsonii; R. parfaiti; R. weberi; R. sabae*).

On June 25 the third instalment of new forms from the Indian Ocean was published. These were:

Comatula micraster.
Comaster parvus.
Mariametra margaritifera.
Cenometra herdmani.
Cenometra insueta.
Cyllometra soluta.
Asterometra mirifica.
Asterometra acerba.
Crotalometra sentifera.
Thalassometra attenuata.
Pachylometra invenusta.
Psathyrometra gracillima.
Trichometra obscura.
Hypalocrinus liliaceus.
Bathycrinus woodmasoni.
Bathycrinus paradoxus.

A new genus, *Mariametra* (genotype *Himerometra subcarinata* A. H. Clark, 1908) is diagnosed, and attention is called to the similarity of *Bathycrinus paradoxus* and Perrier's *Ilyocrinus recuperatus*, and to the similarity of both to Crema's *Apiocrinus recubariensis*.

On August 23 five more comatulids were described, which were:

Comanthus (*Comanthus*) *pinguis.*
Comanthus (*Comanthus*) *samoana.*
Craspedometra aliena.
Amphimetra parilis.
Ptilometra splendida.

Under the heading "Genus *Comanthus* A. H. Clark" appear the subheadings "Subgenus *Comanthus* A. H. Clark" and "Group *Bennettia* A. H. Clark." Thus the new name *Bennettia* is to all intents and purposes a generic name under which two species, *pinguis* and *samoana*, are described.

Further changes in the systematic treatment of the comatulids were suggested on September 14.

The comatulids as a whole were divided into three suborders, which were described in detail; these were:

Comatulida Innatantes (including the Marsupitidae and Uintacrinidae).

Comatulida Oligophreata (including the Comasteridae, Zygometridae, Himerometridae, Colobometridae, Thalassometridae, and Tropiometridae).

Comatulida Macrophreata (including the Antedonidae, Atelecrinidae, and Pentametrocrinidae).

The following new family was described:

Pontiometridae (*Pontiometra*).

The following new subfamilies were described:

Capillasterinae (*Nemaster*, *Capillaster*, *Neocomatella*, *Comatella*, *Comatilia*, *Leptonemaster*, and *Comissia*).

Comactiniinae (*Comatula*, *Comactinia*, and *Cominia*).

Himerometrinae (*Amphimetra*, *Himerometra*, *Craspedometra*, and *Heterometra*).

Stephanometrinae (*Oxymetra* and *Stephanometra*).

Mariametrinae (*Mariametra* and *Dichrometra*).

Antedoninae (*Antedon*, *Mastigometra*, *Compsometra*, and *Iridometra*).

Perometrinae (*Perometra*, *Erythrometra*, and *Hypalometra*).

Zenometrinae (*Zenometra*, *Psathyrometra*, *Leptometra*, *Adelometra*, and *Balanometra*).

Heliometrinae (*Promachocrinus*, *Heliometra*, *Trichometra*, *Hathrometra*, and *Isometra*).

Thysanometrinae (*Eumetra*, *Thysanometra*, and *Coccometra*).

Bathymetrinae (*Bathymetra* and *Thaumatometra*).

The following new genera were described:

Neocomatella (genotype *Antedon alata* Pourtalès, 1878).

Pterometra (genotype *Ptilometra trichopoda* A. H. Clark, 1908).

Balanometra (genotype *Antedon balanoides* P. H. Carpenter, 1888).

Dissection showed that the supposed syzygy between the ossicles of the IBr series and first two brachials in a specimen of *Comatula pectinata* from the Philippine Islands was in reality only an exceptionally close synarthry; in a specimen of *Comaster novae-guineae* [*fruticosus*] the proximal syzygy was found to be in reality intermediate in character between a synarthry and a syzygy, and the name pseudosyzygy was proposed for this type of articulation. Thus the statement previously made (in the paper on the brachial homologies) that syzygyies are associated only with oblique muscular articulations and synarthries only with straight muscular articulations is found to hold good excepting only in the family Zygometridae.

In October a paper was published in which an attempt was made to explain the origin and significance of the nonmuscular articulations, syzygies and synarthries, in the crinoids. It was assumed that in the transformation of the crinoid arm from the primitive biserial to the secondary monoserial type certain articulations became superposed; the synarthry was supposed to have resulted from the superposition of two straight muscular articulations, and the syzygy from the superposition of two oblique muscular articulations. The structure of the crinoid arm was discussed in considerable detail, and homologies with the ambulacral structures of other echinoderms suggested.

On October 30 a revision of the phylum Echinodermata was published in which the following scheme of classification was adopted:

PHYLUM ECHINODERMATA

I. Subphylum Echinodermata Heteroradiata:
    1. Class Pelmatozoa—
        a. Subclass Crinoidea.
        b. Subclass Cystoidea.
        c. Subclass Blastoidea.
    2. Class Echinoidea.
    3. Class Holothuroidea (Bohadschoidea).
II. Subphylum Echinodermata Astroradiata:
    1. Class Ophiuroidea.
    2. Class Asteroidea.

In a paper published in November reasons are given for considering the echinoids and crinoids to be closely allied and both to be closely related to the holothurians, and the following classification is suggested:

PHYLUM ECHINODERMATA

I. Subphylum Echinodermata Heteroradiata:
    A. Pelmatozoa—
        1. Crinoidea.
        2. Cystidea.
        3. Blastoidea.
    B. Ovozoa—
        1. Echinoidea.
    C. Verniformes.
        1. Holothuroidea (Bohadschoidea).
II. Subphylum Echinodermata Astroradiata:
    A. Ophiobrachiata—
        1. Ophiuroidea.
    B. Stellarides.
        1. Asteroidea.

The complete report on the crinoids of the Zoological Museum at Copenhagen appeared on November 16. In the introduction all the *nomina nuda* published by Lütken in the several "Catalogues" of the Museum Godeffroy were identified, together with all the other manuscript names by the same author which could be found. A number of points in the ecology and distribution of the recent crinoids and *Uintacrinus* were discussed. It is suggested that side and covering plates may have arisen through the detachment of produced ventrolateral margins of the brachials and pinnulars. The origin of the Mediterranean and Atlantic crinoid faunas from that of the Indo-Pacific region is explained.

The genus *Comanthus* is divided into three subgenera, as follows:

Comantheria (genotype *Antedon briareus* Bell).

Comanthina (genotype *Actinometra nobilis* P. H. Carpenter).

Comanthus, s. s. (genotype *Comanthus intricata* A. H. Clark = *Actinometra valida* P. H. Carpenter).

The subgenus *Comanthus* as restricted includes two incompletely differentiated groups to which the following new names are applied:

Bennettia (genotype *Alecto bennetti* J. Müller, 1841).

Validia (genotype *Comatula rotalaria* Lamarck, 1816).

The following names are included in the synonymy of *Comanthus* (*Comanthus*) *rotalaria* (Lamarck): *rotalaria*, *parvicirra*, *timorensis*, *wahlbergii*, *brevicirra*, *trachygaster*, *intricata*, *mertensi*, *armata*, *polymorpha*, *simplex*, *meyeri*, *mutabilis*, *annotea*, *elongata*, *simplex* (2), *quadrata*, *guttata*, *orientalis*, and *helianthus*.

The variation in the length of the anterior arms in *Comatula pectinata* and their occasional extreme attenuation are described, and specimens of that species with more than 10 arms are recorded.

The new family Colobometridae is created to include the genera *Oligometra*, *Cyllometra*, *Colobometra*, and *Cenometra*.

The new species included are:

Amphimetra formosa.
Heterometra aspera.
Colobometra vepretum.
Stenometra dorsata.

Amphimetra formosa is not described; the first reference shows that the species is based upon a specimen dredged at *Albatross* station 5138, Philippine Islands, and at first considered conspecific with *A. discoidea* from Queensland; a detailed description was drawn up for publication in volume 36 of the Proceedings of the United States National Museum, and it was assumed that this description would appear before the report upon the Copenhagen collections, but it was later withdrawn. A specimen was recorded in the Copenhagen collection from Singapore and its essential characters given; the characters distinguishing this form from *A. discoidea* are also given.

Stenometra dorsata is not described, but the characters of two of the specimens are given. It is the Japanese species previously recorded as (*Stenometra*) *quinquecostata* of P. H. Carpenter.

A list of the 24 species of comatulids collected in shallow water at Singapore by Mr. Svend Gad is appended; 2 additional species known from Singapore are cited; and 13 additional genera, undoubtedly including shallow water species in the same region, are given.

In a paper published in January, 1910, the origin of the muscular articulations of the crinoids was discussed; the muscle pairs in the crinoids were assumed to be as a whole homologous with the longitudinal muscles of the echinoids (Echinothuridae) and holothurians. Since the ligaments of the syzygies are identical in structure with those of the dorsal ligament bundles of the muscular articulations, the breaking apart of the syzygies is assumed to result automatically from any stimulus, such as panic, which causes the ventral muscles to become inert and the dorsal ligament fibers to contract to the fullest extent, this contraction being accompanied by a much less contraction of the syzygial fibers which, being very short and normally under more or less tension, are torn across. In adolescent autotomy the syzygies are assumed to be broken across by growth changes.

A new comatulid from the Solomon Islands, *Colobometra diadema*, was described on March 23.

In one paper published in April the similarity of the nervous system of the crinoids to that of the arthropods was discussed, and in another the pentamerous symmetry of the crinoids was considered. It was pointed out that in the case of 4-rayed comatulids it is always the anterior ray that is missing, and that therefore 5-rayed examples are the equivalent of 4-rayed individuals plus the addition of half of a pair of appendages between the two of the anterior pair. It is suggested that the 5-rayed condition may have arisen in this way from a 4-rayed bilaterally symmetrical ancestor, and a step in this direction is seen in the case of those 5-winged insects (a 5-winged specimen of *Platysamia cecropia* is figured) in which the additional wing is inserted in advance of one of the wings of the anterior pair. It is stated that larval echinoderms are as extraordinarily specialized as the adults, but along radically different lines, and therefore they must be treated almost as a different class of animals from the adults, specialized along entirely different lines and fitted for an entirely different mode of life.

In a third paper published in April attention was called to the striking similarity between the side- and covering-plates of the crinoids and the scutes developed in winter along the sides of the toes in the ruffed grouse (*Bonasa umbellata*) to increase the area of the foot. It is suggested that the adambulacral plates in the crinoids serve in the same way to increase the area upon which minute animals in falling would be conducted to the mouth, and further that the prevalence of these plates in the crinoids of deep water and their almost entire absence in the crinoids of the littoral may be due to the fact that, while the former depend chiefly for their food upon dead animals falling from above, the latter subsist upon living microplankton, which naturally would recoil from contact with these plates.

The phylogenetic interrelationships of the recent crinoids (considered entirely apart from the fossil species) were considered in a paper published on May 3. The characters used are almost entirely those found in the column. The groups in phylogenetic sequence are:

- Holopodida:
    - *Holopus.*
- Ptilocrinida:
    - First group—
        - Rhizocrinidae (*Rhizocrinus; Bathycrinus*).
        - Phrynocrinidae (*Phrynocrinus*).

Ptilocrinida—Continued.
  Second group; Hyocrinoida—
    Ptilocrinidae (*Ptilocrinus; Calamocrinus*).
    Hyocrinidae (*Hyocrinus; Gephyrocrinus*).
Comatulida:
  Pentacrinitidae.
  Comatulida.

Hyocrinus is assumed to possess the simplest type of column.

The comatulids and pentacrinites are considered to be on essentially the same phylogenetic plane; in the former the column is suppressed, while in the latter it undergoes excessive development.

The reduction of the calyx plates in the comatulids and pentacrinites from their primitive status as elements of a capsule inclosing the visceral mass to the status of a platform consisting of three alternating circlets of five plates each superposed upon each other is explained. It is pointed out that a parallel metamorphosis has taken place in *Bathycrinus*, but here the plates have moved directly inward toward the chief axis of the animal forming a column on the distal end of which the visceral mass rests.

Through Dr. W. Weltner and Dr. R. Hartmeyer, the collections of the Berlin Museum, including such of Müller's types as are in that institution, had been sent to me, and among them I found the specimen described as *Alecto purpurea*, which was redescribed and figured on May 27. That it is a valid species was shown by a large number of specimens included in the collection of the Australian Museum, which had also been sent to me through the courtesy of Dr. R. Etheridge, jr.

On June 6 the origin of certain types of crinoid stems was discussed. Attachment by a primitive central plate which increases in size (as in *Holopus*) was assumed to be followed by fracture and a subsequent free existence (as in *Edriocrinus*) or by the breaking of the stem in so far as its calcareous structure is concerned, the resultant parts maintaining organic continuity, a process which may be indefinitely repeated, resulting in a series of columnals with the fulcral ridges on the two ends alternating in direction; in other words, a column comparable to that of *Rhizocrinus*, *Bathycrinus*, or the young of *Antedon*. Such a column in its primitive form is limited in size through mechanical considerations; to counteract these the individual columnals may become greatly shortened (as in *Phrynocrinus*), the fulcral ridges on either end of each columnal may depart only slightly in direction (as in *Platycrinus*), or the original fulcral ridge may disintegrate, each half breaking up longitudinally and spreading out fan-like, the two figures eventually uniting to form an articular surface composed of numerous uniform radiating lines. The columnals of the pentacrinites are of the last type, modified by being molded or cast into petaloid sectors by the under surface of the basals against which they are formed. In a footnote mention is made of a new genus, *Proisocrinus*, in which the lower part of the column resembles that of *Calamocrinus*, the upper that of *Isocrinus*.

On June 7 a new comatulid, *Compsometra lacertosa*, was described from Australia, and on June 18 the species of *Antedon* occurring at Trieste was given the name of *Antedon adriatica*, and various points regarding the other species of the genus were discussed. On August 6 a new genus of stalked crinoid, *Proisocrinus*, with the type species *P. ruberrimus*, was described, and on January 11, 1911, another new genus of stalked crinoid, *Thalassocrinus*, with the type species *Th. pontifer*, related to *Gephyrocrinus*.

In 1906 Mr. Henry W. Nichols had published an analysis of the skeleton of a specimen of *Metacrinus rotundus*, in which he found 11 per cent of magnesium carbonate. This relatively high percentage of magnesium carbonate had attracted my attention, and I sent specimens of *Metacrinus rotundus* and *Heliometra glacialis* var. *maxima* to Prof. F. W. Clarke, of the United States Geological Survey, for analysis to verify Nichols' figures. The results of the analyses were published by myself on January 11, 1911.

On February 15 the third paper on the crinoids collected by the *Albatross* in Philippine waters appeared. In this paper 59 species were recorded, of which 24 were described as new; the latter were:

Comissia dumetum.
Comissia hispida.
Comaster fruticosus.
Comaster (?) *horridus.*
Comaster (?) *scitulus.*
Zygometra pristina.
Catoptometra ophiura.
Selenemetra viridis.
Epimetra nympha.
Oligometra gracilicirra ornata.
Calometra alecto.
Asterometra magnipeda.
Asterometra cristata.
Cosmiometra philippinensis.
Crotalometra propinqua.
Crotalometra infelix.
Thalassometra hirsuta.
Stenometra cristata.
Pachylometra septentrionalis.
Pachylometra luna.
Pachylometra selene.
Chlorometra robusta.
Iridometra melpomene.
Toxometra paupera.
Psathyrometra parva.

One of the above, *Pachylometra septentrionalis*, is from southern Japan and is the specimen recorded in the report on the Owston collection under the name of *Charitometra distincta*.

The new genera described were:

Selenemetra (genotype *Selenemetra viridis*, sp. nov.).
Epimetra (genotype *Epimetra nympha*, sp. nov.).
Toxometra (genotype *Toxometra paupera*, sp. nov.).

The very peculiar articulation between the ossicles of the IBr series in *Zygometra pristina* was described in detail.

On March 15 there appeared a memoir on the recent crinoids of the coasts of Africa based upon a review of all the African material in the European museums, as well as upon a compilation of all the published records. In the introduction the history of the development of the African fauna is traced in detail and the zoogeographic aspects of the region are explained.

The African crinoid fauna falls into five divisions, as follows:

1. The European division, including the Mediterranean coast and the northwest coast of Morocco, and Madeira; this falls into two subdivisions:

(*a*) The Mediterranean subdivision, comprising the coast of the Mediterranean, and (*b*) The European-Atlantic subdivision, extending on the Atlantic coast from Madeira and Morocco northward;

2. The South European-Northwest African-Antillean division, extending from Madeira and Morocco northward to the Bay of Biscay and westward to and including the Caribbean Sea;

3. The West African-South American division, including the coast south of Morocco and the opposite coast of Brazil, with the intervening islands;

4. The Southeast African division, extending from Mombasa to Cape Town, and eastward to include Madagascar, the Seychelles, Réunion and Mauritius, and the intervening islands eastward to the Chagos Archipelago; the southern part of this division, comprising the coasts of Cape Colony and Natal, forms the Cape subdivision; and

5. The Northeast African division, extending from Somaliland northward throughout the Red Sea and eastward to the Persian Gulf.

The West African-South American division is an attenuated offshoot from the South European-Northwest African-Antillean division, which itself is derived from the Southeast African division, the last the somewhat modified southwestern extremity of the great Indo-Pacific-Japanese faunal area. The European faunal division is probably an attenuated offshoot from the Northeast African division, which itself is the considerably modified northwestern extremity of the great Indo-Pacific-Japanese faunal area.

A comparative table showing the West Indian comatulid genera and the corresponding East Indian genera is given; included among the West Indian genera is *Analcidometra*, paired with *Stephanometra*, a *nomen nudum*.

It is stated that the crinoid fauna of the entire west coast of North and South America is Magellanic in its affinities, in striking contrast to the conditions in the Caribbean Sea. No crinoid appears ever to have passed the Isthmus of Panama in either direction, and there is not even a subfamily common to the two sides.

The previously described species recorded are:

Comatella maculata.
Capillaster multiradiata.
Comanthus (*Bennettia*) *wahlbergii.*
Comanthus (*Validia*) *parvicirra.*
Heterometra savignii.
Stephanometra marginata.
Stephanometra indica.
Dichrometra protectus.
Dichrometra palmata.
Dichrometra klunzingeri.
Dichrometra flagellata.
Cenometra emendatrix.
Tropiometra carinata.
Tropiometra picta.
Crotalometra magnicirra.
Crotalometra porrecta.
Crotalometra flava.
Thalassometra lusitanica.
Thalassometra omissa.
Thalassometra multispina.
Pachylometra sclateri.
Antedon bifida.
Antedon mediterranea.
Antedon hupferi.
Leptometra celtica.
Leptometra phalangium.
Pentametrocrinus altanticus.
Endoxocrinus wyvillethomsoni.
Gephyrocrinus grimaldii.
Bathycrinus aldrichianus.
Bathycrinus gracilis.
Bathycrinus perrieri.
Bathycrinus recuperatus.
Rhizocrinus parfaiti.
Rhizocrinus chuni.

The record of *Comatella maculata* is based upon the specimen recorded by Bell as *Actinometra multiradiata*, which was examined in the British Museum.

Notes are included which were taken from the African specimens of *Capillaster multiradiata* in the Paris Museum.

Comanthus wahlbergii is shown to be a valid species, and the differential characters are given from specimens in the British Museum.

Antedon emendatrix Bell is identified as a species of *Cenometra*, and the *Antedon spicata* recorded by Bell is the same species.

From a study of the original specimens in the Paris Museum, Gay's *Comatula picta* is identified as *Tropiometra picta*, and the differential characters between this form and *T. carinata* are given.

The new species described are:

Capillaster multiradiata coccodistoma.
Comissia ignota.
Amphimetra africana.
Craspedometra ater.
Craspedometra madagascarensis.
Heterometra joubini.
Heterometra gravieri.
Colobometra chadwicki.
Decametra möbiusi.
Decametra modica.
Decametra alaudae.
Oligometra serripinna occidentalis.
Tropiometra encrinus.
Cosmiometra gardineri.
Iridometra mauritiana.
Iridometra aegyptica.
Perometra afra.

Comissia ignota was recorded in the *Alert* report merely under the generic name *Actinometra*, and was found in the British Museum labeled "*Actinometra pectinata.*"

Colobometra chadwicki is the species recorded by Chadwick from Suez under the name of *Antedon serripinna*.

Undetermined species of *Neocomatella*, *Comanthus*, and *Dichrometra* were recorded, and 19 records of unidentifiable species are reproduced.

Thirteen pentacrinoids of *Comanthus wahlbergii* are noted as having been studied in the British Museum.

The new generic name *Decametra* appears; no diagnosis is given, but three new species—*möbiusi*, *modica*, and *alaudae*—are described as belonging to the genus; *D. informis* and *D. taprobanes* are also mentioned.

In an appendix a species listed under a new name, *Oligometra serripinna* var. *electrae* (*nomen nudum*), is recorded from the Red Sea, and four new species are recorded from northwest of Socotra—three under the generic names only and the fourth as *Cyclometra flavescens* (*nomen nudum*).

On May 15 a new genus, *Cyclometra*, was described to which two species were assigned, *C. flavescens*, sp. nov. (the genotype) and *C. clio* (*Antedon clio* A. H. Clark, 1907). On the same date it was suggested that the recent stalked crinoid mentioned by Sir Richard Owen as having been obtained in 8 fathoms was probably an Umbellularian.

The collection of the Leyden Museum, specimens in which had previously been described by Johannes Müller in 1841 and by P. H. Carpenter in 1881, was discussed in a paper published in May. Carpenter's *Actinometra robustipinna* was found to be a species of *Himerometra*.

In a short paper published in May a new comatulid, *Comissia pectinifer*, was described from Christmas Island, and a list of the known species of the genus was appended, and in June the hypothetical development and inherent characters of a genus were discussed.

On June 24 two papers appeared; in the first of these the structure of the species of *Comaster* was considered and a new species, *Comaster taviana* (previously referred to as *Phanogenia carpenteri*) was described; and in the second the reasons for believing *Marsupites* to be a comatulid and closely related to *Uintacrinus* are given in detail.

In August the comparative age of the recent crinoid faunas was considered on the basis of the inherent characteristics of each faunal unit.

On August 19 a paper was published on the nervous system and the symmetry of the crinoids. The crinoidal nervous system is in effect composed of five interradial nerves and their derivatives, each of these nerves being comparable to a single double ventral nerve cord of an arthropod or annelid. The chiasmas within the axillaries appear to be repetitions of the nerve branchings within the calyx. The circumoral nerve ring and the ambulacral nerves together are the equivalent of the supraoesophageal ganglion in the annelids or the arthropods. Each axillary is a sort of dissociated radial. The five divisions of the body in the echinoderms consist of the five interambulacral areas plus half of the ambulacral area on either side. The echinodermal skeleton was originally merely a spicular layer developed in the mesoderm of the body wall.

The next article to appear was an account of the collection of crinoids of the Paris Museum previously studied by Lamarck, J. Müller, and P. H. Carpenter and containing types of additional species described by Guettard, d'Orbigny, Perrier, Koehler, and Vaney, as well as many specimens named, though not described, by Valenciennes.

Lamarck's *Comatula rotalaria* was found to be the same as the species described by P. H. Carpenter as *Actinometra jukesii* and by Bell as *Actinometra paucicirra*, and therefore entirely different from the *Actinometra rotalaria* (= *Comanthus parvicirra*) of the *Challenger* report. The history of Müller's *Alecto multifida* was given in detail, and the type specimen was redescribed. Müller's *Alecto philiberti* was found to be the same as the subsequently described *Amphimetra mortenseni*. Bell's *Antedon bidens* proved to be the same as Lamarck's *Comatula adeonae*. As was suspected at the time it was described, *Ptilometra dorcadis* proved to be a synonym of Müller's *Comatula macronema;* the cirri of *macronema* and of the corresponding species (*mülleri*) from southeastern Australia were figured.

The comatulids brought back by the French scientific mission to Cape Horn were described.

The new species included were:

Heterometra joubini.
Heterometra gravieri.
Oligometra caledoniae.
Trichometra delicata.

During a visit to Hamburg in the summer of 1910 Prof. W. Michaelsen asked me to undertake the study of the crinoids which he and Dr. R. Hartmeyer had collected in Western Australia. I had just completed a monograph on the crinoids of

Australia for the Australian Museum, but had not been able to examine any Western Australian material excepting the two or three specimens recorded in the *Gazelle* report, and so this offer was more than usually attractive.

The report upon Doctor Michaelsen's collection begins with a detailed history of the work done in the region, with a bibliography, followed by a detailed discussion of the faunal relationships of the Australian coasts and an annotated list of the species represented. These are the following:

Comatulella brachiolata.
Comatula purpurea.
Comaster typica.
Comantheria briareus.
Comanthina belli.
Comanthus (Bennettia) trichoptera.
Comanthus (Vania) annulata.
Zygometra microdiscus.
Zygometra elegans.
Amphimetra discoidea.
Dichrometra tenera.
Ptilometra macronema.
Compsometra incommoda.

The generic name *Comatulella* is new, but it appears merely in combination with (*Comatula*) *brachiolata* of Lamarck.

Comatulella brachiolata, previously known only from Lamarck's original description and Müller's description of *Alecto rosea*, is discussed in great detail on the basis of a specimen from Port Phillip in the British Museum and others in the present collection from Koombana Bay and (?) vicinity of Perth.

It is pointed out that many species inhabiting relatively cold water differ from the comparable species inhabiting warmer water in having short and stout arms and short-segmented cirri. While cold appears to delay the metabolic processes so that the formation of the skeleton outstrips the growth of all the other structures, causing the arms to become short and stout, warmth seems to attain the same end by inducing a very rapid and early development of the sexual products which hinders the development of all the other structures, though it has no effect upon the skeleton formation. Whereas arm shortening by cold progresses equally on all the arms, arm shortening by warmth-induced sexual maturity affects, in the Comasteridae, the posterior arms first and is very often entirely confined to them. This is said to be due to their relative remoteness from the ring systems about the excentric mouth. Attention is called to the "pseudo-biserialism" in the arms of *Comatulella brachiolata.*

A specimen of *Dichrometra tenera* with 7 rays and 57 arms is recorded.

Young specimens of *Ptilometra macronema* are described. *Antedon wilsoni* of Bell and *Himerometra paedophora* of H. L. Clark are the young respectively of *Pt. macronema* and *Pt. mülleri.*

The memoir ends with a list showing the association of species and a list of the unidentified crinoids reported from Western Australia.

The genus *Ptilometra* is placed under the family Thalassometridae instead of under the family Tropiometridae as previously.

The monograph on the recent crinoids of Australia, based on the collections of the Australian Museum at Sydney, appeared on August 17. In the introduction the importance of the study of the recent crinoids is emphasized and the present status of the subject is outlined. A detailed history of the development of the knowledge of the Australian crinoid fauna is given. The zoogeographic relationships of the Australian coasts are discussed and the past history of the recent crinoid faunas is sketched.

Keys are given to all the Australian families, genera, and species.

The family Tropiometridae is restricted to cover the genus *Tropiometra* only; *Ptilometra*, *Pterometra*, and *Asterometra* are assigned to the Thalassometridae, and a new family, Calometridae, is created for the genus *Calometra*. The subfamily Charitometrinae is raised to family rank.

The new generic name *Solanometra* appears; there is no diagnosis, but the genotype, *Antedon antartica* P. H. Carpenter, is mentioned.

Vania, a new specific group in the subgenus *Comanthus*, is diagnosed with the genotype *Alecto parvicirra* J. Müller. The intent of *Vania* is identical with that of *Validia*, which it replaces. The genotype of *Validia* was given as *Comatula rotalaria* Lamarck, on the strength of Carpenter's description of *Actinometra rotalaria* in the *Challenger* report; but examination of Lamarck's types at Paris showed his *rotalaria* to be a very different animal from that called *rotalaria* by Carpenter.

A new species, *Comatula etheridgei*, is described from specimens in the British Museum.

The name *Zygometra comata* is proposed for the species recorded from Singapore under the name of *Z. fluctuans;* examination of the type of *fluctuans* in the British Museum shows that it is the same as *Z. elegans.*

Antedon wilsoni Bell and *Ptilometra dorcadis* are synonyms of *Ptilometra macronema; Himerometra paedophora* H. L. Clark is a synonym of *Pt. mülleri.*

The memoir ends with a list of unidentifiable records, a complete bibliography, and a reprint of Wilton's article describing *Encrinus australis* from Newcastle, New South Wales.

On March 19, 1912, two papers appeared. In the first a new genus, *Naumachocrinus* (genotype *Naumachocrinus hawaiiensis*), related to *Phrynocrinus* was described, and in the second 17 new comatulids of the families Comasteridae and Zygometridae from the collections of the Dutch steamer *Siboga* were established. These were:

Capillaster gracillirra.
Capillaster tenuicirra.
Comissia littoralis.
Comissia parvula.
Comissia gracilipes.
Comissia spinosissima.
Comatula tenuicirra.
Cominia australis.
Comaster sibogae.
Comaster pulcher.
Comantheria weberi.
Comantheria rotula.
Comanthus crassicirra.
Zygometra punctata.
Eudiocrinus junceus.
Eudiocrinus pinnatus.
Eudiocrinus venustulus.

A new genus also was proposed, *Palaeocomatella* (genotype *Actinometra difficilis* P. H. Carpenter, 1888).

The six new species of Charitometridae in the *Siboga* collection were described on April 13; these were:

Pachylometra crassa.
Pachylometra helius.
Pachylometra fragilis.
Glyptometra timorensis.
Strotometra priamus.
Strotometra ornatissimus.

Eleven new species of the families Calometridae and Thalassometridae were described on April 23; these were:

Neometra sibogae.
Calometra diana.
Pterometra venusta.
Thalassometra marginalis.
Thalassometra magna.
Thalassometra margaritifera.
Thalassometra perplexa.
Crotalometra sulcata.
Crotalometra vera.
Cosmiometra helene.
Stenometra acuta.

Neometra, used as a generic name in the description of *Neometra sibogae* and appearing in the text in combination as *Neometra multicolor*, is new.

A paper on the crinoids of the Solomon Islands appeared on April 26, and another on a small collection from the Indian Ocean on July 10. In the latter the following new species are described:

Zygometra andromeda.
Oligometra intermedia.

The following *nomina nuda* occur:

Heterometra pulchra.
Prometra brevicirra.
Psathyrometra major.
Psathyrometra inusitata.

The generic name *Prometra* is new.

Eleven new comatulids from the *Siboga* collections belonging to the families Himerometridae, Mariametridae, and Colobometridae were described on June 29. These were:

Amphimetra propinqua.
Selenemetra tenuicirra.
Mariametra tenuipes.
Mariametra tuberculata.
Dichrometra tenuicirra.
Cyllometra gracilis.
Decametra mylitta.
Prometra laevipinna.
Prometra minima.
Prometra parva.
Oligometra marginata.

Decametra mollis, which is compared with *D. mylitta*, is a *nomen nudum*.

Included in the collections made by the German South Polar (*Gauss*) Expedition was a large series of the pentacrinoid young of *Promachocrinus kerguelensis*. A preliminary study of these and of other pentacrinoids at hand, especially pentacrinoids of *Comactinia meridionalis*, showed that the so-called anal in the pentacrinoid larvae of the recent comatulids is in reality the radianal of the fossil forms. Anal x is represented in the pentacrinoid larvae of the comatulids by a posterior interradial which gives rise to an additional post-radial series, as in *Thaumatocrinus renovatus* and in six-rayed specimens of other species, or by a minute plate which is quickly resorbed; in the recent forms it is repeated in all the interradial areas. *Thaumato-*

crinus renovatus is merely the young of *Decametrocrinus abyssorum*. The solid plating of the disk which appears in the young of certain forms concurrently with the disappearance of the orals, quickly to be resorbed, is the transient vestige of the condition which developed into the solid dome of the Camerata. These conclusions were published on July 19.

On November 7 an account appeared of the crinoids of the Natural History Museum at Hamburg, a very important collection containing the types of many species described by P. H. Carpenter and by Hartlaub, the original of Lovén's *Hyponome sarsii*, many interesting specimens from Spitzbergen, the Magellanic region and Ternate, and part of the old collection of the Museum Godeffroy previously studied by Lütken. The new species described were:

Dichrometra flagellata var. *afra.*
Petasometra helianthoides.
Euantedon sinensis.

The new genera established were:

Petasometra (genotype *Antedon clarae* Hartlaub, 1890).

Euantedon (genotype *Antedon moluccana* A. H. Clark, 1912).

Actinometra belli P. H. Carpenter is transferred from *Comanthina* to *Comaster.*

Antedon tenera Hartlaub, 1890, and *Antedon reginae* Bell, 1884, are placed in the synonymy of *Dichrometra gyges* (Bell).

Tropiometra macrodiscus (Hara) is recognized as distinct from *T. afra* (Hartlaub).

The combination *Solanometra magellanica* appears for the first time.

In April descriptions of the new species contained in the *Siboga* collection belonging to the families Antedonidae and Atelecrinidae were published. These new species were:

Antedon moluccana.
Compsometra iris.
Compsometra parviflora.
Compsometra longicirra.
Compsometra gracilipes.
Iridometra (*Eumetra*) *aphrodite.*
Iridometra gracilis.
Toxometra purpurea.
Psathyrometra major.
Psathyrometra minima.
Psathyrometra inusitata.
Psathyrometra anomala.
Nanometra clymene.
Trichometra delicata.
Trichometra brevipes.
Thaumatometra alcyon.
Thaumatometra thysbe.
Atopocrinus sibogae.
Atelecrinus sulcatus.
Atelecrinus anomalus.

The new genus *Atopocrinus* (genotype *Atopocrinus sibogae,* sp. nov.) was described.

The separates of this paper were lost in the sinking of the *Titanic.*

In a paper published on November 19 attention was called to the apparent occurrence of five distinct nodes or centers of abundance in the bathymetrical distribution of the recent crinoids which are in their distribution roughly inversely proportionate to the decrease in temperature with depth.

On the following day there appeared a description of the recent crinoids contained in the collection of the Berlin Museum. In the introduction the history of the collection is given together with a list of all the records published based upon the included specimens. A complete bibliography is appended.

The new species described are—

Comissia hartmeyeri.
Tropiometra audouini.

Tropiometra audouini is compared with *T. indica* (new name) from Ceylon.

Dichrometra palmata is stated to be confined to the Red Sea; the individuals from Singapore and New Guinea recorded as *palmata* represent in reality *D. protectus.*

Hartlaub's *Antedon klunzingeri* is a synonym of *D. palmata,* and Carpenter's *Antedon quadrata* is a synonym of *Heliometra glacialis.*

The complete report upon the crinoids of the Indian Museum, including the *Investigator* collections, appeared on November 22 as a comprehensive memoir on the crinoids of the Indian Ocean, or rather of the entire Indo-Pacific-Japanese faunal region, including an historical introduction, a minute analysis of the fauna, a detailed discussion of the zoogeography, by regions and by groups, keys to the orders, families and genera, and a complete bibliography.

In this the three subfamilies of Himerometridae, Himerometrinae, Stephanometrinae, and Mariametrinae, were raised to family rank.

The following new genera were described:

Oreometra (genotype *Oreometra mariae,* sp. nov.).
Neometra (genotype *Antedon multicolor* A. H. Clark, 1907).
Gephyrometra (genotype *Antedon versicolor* A. H. Clark, 1907).
Pectinometra (genotype *Antedon flavopurpurea* A. H. Clark, 1907).
Comastrocrinus (genotype *Hypalocrinus springeri* A. H. Clark, 1909).

The following new species were described:

Himerometra sol.
Decametra arabica.
Oligometra concinna.
Oreometra mariae.
Thalassometra marginata.
Stiremetra carinifera.
Trichometra plana.
Metacrinus batheri var. *gracilis.*
Comatella decora.

The following new names were proposed:

Himerometra pulcher (for *Himerometra robustipinna* A. H. Clark, 1908, not *Actinometra* [*Himerometra*] *robustipinna* P. H. Carpenter, 1881).

Craspedometra amboinae (for *Antedon ludovici* Hartlaub, 1891, in part).

In an appendix additional species received after the main part of the work had gone to press are recorded, and the following new forms are described:

Comissia chadwicki.
Eudiocrinus gracilis.
Heterometra pulchra.
Dichrometra ciliata.
Colobometra (*Prometra*) *brevicirra.*
Oligometra serripinna var. *erinacea.*

The new subgenus *Prometra* (genotype *Colobometra chadwicki* A. H. Clark, 1911) is established.

In April, 1913, a supplement to the report upon the crinoids of Western Australia collected by Doctors Michaelsen and Hartmeyer was published, and at about the same time a paper on a collection of crinoids from the waters about Ireland appeared. In the latter the following new species were described:

Trichometra hibernica.
Atelecrinus helgae.

On June 30 a revision of the family Mariametridae was published in which the family Pontiometridae was suppressed, and the following genera were recognized:

Pontiometra (genotype *Antedon andersoni* P. H. Carpenter, 1889).

Oxymetra (genotype *Antedon erinacea* Hartlaub, 1890).

Liparometra, gen. nov. (genotype *Himerometra grandis* A. H. Clark, 1908).

Lamprometra, gen. nov. (genotype *Antedon imparipinna* P. H. Carpenter, 1882).

Dichrometra (genotype *Alecto flagellata* J. Müller, 1841).

Mariametra (genotype *Himerometra subcarinata* A. H. Clark, 1908).

The bathymetrical and geographical range of each genus is given, together with a list of the included species. The family is redefined, and a key to the genera is included.

In a paper published in July the relationships between the recent crinoids and their environment and between the recent and the fossil species were considered in great detail, particular attention being paid to the stalked forms. *Hyocrinus*, *Thalassocrinus*, *Gephyrocrinus*, *Calamocrinus*, and *Ptilocrinus*, together with *Tetracrinus* and *Plicatocrinus*, were placed in the Hyocrinidae, and *Proisocrinus* and *Carpenterocrinus* were considered as equivalent to certain forms in the comprehensive genus *Millericrinus*.

A very detailed revision of the genus *Himerometra* appeared on November 25.

Dr. Charles R. Eastman was preparing a new edition of the Zittel-Eastman "Paleontology," and he requested Mr. Frank Springer and the author to write the section dealing with the crinoids. The classification of the recent crinoids had been built up on the basis of the recent forms alone, quite regardless of their fossil relatives, and it thus became necessary to harmonize the treatment of the two sections of the group, which proved to be a matter of no little difficulty.

All the recent types were assigned to the order Articulata, which was redefined, and the following families, each considered in detail and redefined, were accepted:

1. Bourgueticrinidae (including *Bourgueticrinus*, *Mesocrinus*, (?)*Dolichocrinus*, *Rhizocrinus*, *Bythocrinus*, *Democrinus*, *Bathycrinus*, and *Monachocrinus*).
2. Phrynocrinidae (including *Phrynocrinus* and *Naumachocrinus*).
3. Apiocrinidae (including *Apiocrinus*, *Millericrinus*, *Guettardicrinus*, *Dadocrinus*, *Holocrinus*, *Achrochordocrinus*, *Proisocrinus*, and *Carpenterocrinus*).
4. Pentacrinidae:
    - Section A: Pentacrinids (*Pentacrinus*, *Isocrinus*, *Balanocrinus*, *Austinocrinus*, *Cenocrinus*, *Endoxocrinus*, *Metacrinus*, *Hypalocrinus*, and *Comastrocrinus*).
    - Section B: Thiolliericrinids (*Thiolliericrinus*).
    - Section C: Comatulids—
        - Tribe 1: Innatantes—
            - Subtribe A: Marsupitids (*Marsupites*).
            - Subtribe B: Uintacrinids (*Uintacrinus*).
        - Tribe 2: Oligophreata.
        - Tribe 3: Macrophreata.
5. Plicatocrinidae (including *Plicatocrinus*, *Hyocrinus*, *Gephyrocrinus*, *Thalassocrinus*, *Ptilocrinus*, and *Calamocrinus*).

6. Saccocomidae (*Saccocoma*).

7. Eugeniacrinidae (*Eugeniacrinus, Tetracrinus, Gammarocrinus, Gymnocrinus, Phyllocrinus, Torynocrinus, Trigonocrinus,* and *Eudesicrinus*).

8. Holopidae (including *Cotyloderma, Cyathidium,* and *Holopus*).

The generic name *Monachocrinus* is new; the chief characters and the range are given, but no species are mentioned.

The chief feature of interest in this classification is the recognition of the fact that the pentacrinites and the comatulids form two groups which are in every way strictly parallel and of substantially the same phylogenetic value, though departing in exactly opposite directions from the parent stock. The pentacrinites are characterized by excessive stem growth; the larval stem is lost at a very early age, but new columnals are continuously formed with great rapidity, so that a stem of enormous length results. The distal portion of this stem is continually dying away, so that the actual length of the stem in any individual is but a fraction of the entire length which has been formed during growth. In living comatulids the larval stem is similarly lost; but after this takes place no additional columnals are formed; stem growth continues within the single columnal which remains attached to the calyx; this becomes greatly enlarged and puts forth numerous cirri. Comatulids may be described as pentacrinites in which the entire stem is reduced or limited to the compass of a single columnal, and in which the cirri (when present), unable to arrange themselves in whorls on regularly spaced nodals, are closely packed together on a single nodal.

The genus *Thiollierierinus* is exactly intermediate between the pentacrinites and the comatulids; the stem is developed just to the point at which the two groups diverge, at that point ceasing further growth, as in the comatulids, but being retained as in the pentacrinites. The structure of the stem is the same as that of the larval stem of the pentacrinites and of the comatulids.

The pentacrinites and comatulids are the dominant crinoid forms in the modern fauna. The latter especially are extremely numerous and exist in a vast array of diverse types, none of which, however, depart in any great degree from the general structure of the group, so that their classification necessitates the creation of numerous subfamilies, families, and higher groups which are not systematically comparable to similar groups in the stalked forms.

We were not satisfied with the disposition made of the family Plicatocrinidae, which we regarded as provisional. On December 4 the present author published a paper in which this family was definitely assigned to the Inadunata and placed at the end of the series of families in that order, beyond the Poteriocrinidae. With the addition of the Plicatocrinidae the geological range of the Inadunata is extended from the Ordovician to the recent seas, in which it is the only palaeozoic crinoid order still represented. Mr. Springer, in a footnote, concurred with the conclusions reached.

An account of the recent crinoids, more especially the comatulids, in the British Museum was published on December 31. The general treatment is the same as in the preceding papers on the collections in European museums.

The following new species were described:

Amphimetra flora.

Hybometra senta.

The following new genus was described:

Hybometra (genotype *Hybometra senta*, sp. nov.).

The following new generic names appear:

Oligometrides (no diagnosis; the name appears in combination as *Oligometrides adeonae* [Lamarck]).

Aglaometra (no diagnosis; the name appears in combination as *Aglaometra valida* [P. H. Carpenter] and *Aglaometra incerta* [P. H. Carpenter]).

Anthometra (no diagnosis; the name appears in combination as *Anthometra adriani* [Bell]).

Florometra (no diagnosis; the name appears in combination as *Florometra magellanica* [Bell]).

The following new specific names are included:

Neocomatella europaea (a few characters are given).

Neocomatella atlantica (a few characters are given).

Amphimetra papuensis (a few characters are given).

Hathrometra norvegica (a few characters are given).

On January 4, 1914, a preliminary paper was published showing the circulation of the abyssal water of the oceans as worked out from a study of the distribution of bottom living organisms, particularly crinoids; a much more detailed discussion of the same subject was published on February 25.

The crinoids collected by the Australian fisheries steamer *Endeavour* on the coasts of Western Australia were described in a paper published in 1914. In this the following species were recorded:

Capillaster sentosa.
Capillaster multiradiata.
Comatulella brachiolata.
Comatula purpurea.
Comanthus (Vania) annulata.
Comanthus (Vania) parvicirra.
Zygometra elegans.
Amphimetra discoidea.
Tropiometra afra.
Neometra gorgonia, sp. nov.
Neometra conaminis, sp. nov.
Ptilometra macronema.

In connection with the description of *Neometra gorgonia* and *N. conaminis* the genus *Neometra* is discussed in great detail, and the characters of all the included species are given.

A series of papers now appeared containing a preliminary exposition of many points in the general biology of crinoids and of marine animals in general; the subjects dealt with were the relation between the recent crinoids and the temperature of their habitat (June 20 and December 4), the correlation between the bathymetrical and the geographical range of the recent crinoids, the Atlantic Ocean as primarily an inland sea, and the geographical divisions of the recent crinoid fauna.

From time to time a considerable amount of study had been devoted to the correlation between the marine and the terrestrial and the past and present faunas, and more or less extended observations on these subjects appeared in a series of papers on the distribution of animals and its bearing on the peopling of America (March, 1912), Cambrian holothurians (August, 1913), the deep-sea and comparable faunas (July, 1913), nocturnal animals (February 25, 1914), and the geographical distribution of the Onychophora (January 4, 1915).

Although no crinoids were obtained by the Hamburg expedition to West Africa, the author was requested by Dr. W. Michaelsen to prepare an account of the West African crinoid fauna for inclusion in the series of reports. This paper was published in 1914. In it the Atlantic crinoid fauna was analyzed and its probable origin discussed in detail. The two genera represented in West Africa, *Tropiometra* and *Antedon*, especially the latter, were treated at some length. A key to the species of *Antedon* was given, followed by a list of these species with the range of each. The species recognized were:

Antedon mediterranea.
Antedon adriatica.
Antedon petasus.
Antedon bifida.
Antedon moroccana.
Antedon dübenii.
Antedon hupferi.

Antedon moroccana, though not specifically designated as such, is a new species.

Following a series of papers on the broader aspects of the study of the recent crinoids—on the bathymetrical distribution of Arctic and Antarctic species (February 4), on certain aspects of the bathymetrical distribution of the various species (February 19), on the bathymetrical and thermal distribution of the comatulids occurring on the coasts of China and Japan (March 19), and on the correlation of phylogenetical specialization and bathymetrical distribution (May 4)—there was published on May 16 a monograph of the crinoids of the Antarctic based upon the material brought home by the German South Polar (*Gauss*) Expedition.

In this monograph everything concerning the Antarctic crinoid fauna is included. An historical introduction tracing the development of the knowledge of the Antarctic crinoids is followed by a key to the Antarctic species and an annotated list of all the Antarctic forms with the complete synonymy and range of each and detailed descriptions of the specimens collected by the *Gauss*.

The following new genus is described:

Eumorphometra (genotype *Eumorphometra concinna*, sp. nov.).

The following new species are described:

Psathyrometra antarctica.
Eumorphometra concinna.

The subfamily name Ptilometrinae, first used in the discussion of the relation between the recent crinoids and the temperature of their habitat, appears again, but is still undefined.

The systematic significance of the family Pentacrinitidae is explained in detail. As here understood this family includes three groups—the pentacrinites, the thiolliericrinites, and the comatulids; the last, though phylogenetically a minor offshoot from the main stem and in every way parallel to the other two, has become so enormously developed in the recent seas as to have acquired systematic interrelationships between the included species in all respects comparable to those within a normal class.

A revision of the family Bourgueticrinidae is included in which the following genera are recognized:

Bathycrinus.
Ilycrinus.
Monachocrinus.
Rhizocrinus.
Bythocrinus.
Democrinus.

A key to these genera is given, and the range of each is discussed in detail.

The family Plicatocrinidae, including the recent genera *Calamocrinus*, *Ptilocrinus*, *Hyocrinus*, *Thalassocrinus*, and *Gephyrocrinus*, is assigned to the order Inadunata, and the reasons for this are set forth at length. A key to the recent genera is given.

The genus *Promachocrinus* is made to include the subgenera *Promachocrinus*, *Solanometra*, *Florometra*, and *Anthometra*, and its relationships with *Heliometra* and *Cyclometra*, as well as its probable origin, are discussed in detail.

A list of the localities where species of *Florometra* have been collected, for the most part previously unpublished, is given, and the bathymetrical, thermal, and geographical distribution of the genus is considered.

Keys to the genera of the subfamily Zenometrinae and to the five species of *Thaumatocrinus* are included.

The faunas of South Africa, southern Australia, the Arctic Ocean, the more or less inclosed seas, and of the abysses are analyzed in their relation to the Antarctic fauna, and the sub-Antarctic fossil crinoids are listed.

After a series of papers of more or less general interest, on the relationship between phylogenetic specialization and temperature among crinoids (June 19), on the recent crinoids which are congeneric with fossil species (July), on the relation between the maximum and the average bathymetric range and the mean and the average depth of habitat (July), on the distribution of crinoids on the coasts of Australia (1915), a phylogenetic study of the recent crinoids with special reference to the question of specialization through the partial or complete suppression of structural characters (August 19), and asymmetry among crinoids, the description of the first New Zealand crinoid was published on February 24, 1916. This was:

Comanthus trichoptera benhami.

In this paper the common south Australian comasterid is mentioned under the name of *Comanthus* (*Cenolia*) *trichoptera*. The name *Cenolia* is new, replacing the name *Bennettia*, preoccupied.

On March 4 seven new echinoderm genera were described, including the four following crinoid genera:

Comatonia (genotype *Actinometra cristata* [P. H. Carpenter, MS.] Hartlaub, 1912).

Austrometra (genotype *Oligometra thetidis* H. L. Clark, 1909).

Cotylometra (genotype *Oligometra gracilicirra* A. H. Clark, 1908).

Daidalometra (genotype *Antedon hana* A. H. Clark, 1907).

On June 6 three new crinoids were described from southern Japan, two of them from the collection of Prof. Franz Doflein which had been sent to the author for study. These were:

Comantheria intermedia.
Dichrometra dofleini.
Prometra owstoni.

On October 19 six new genera of Thalassometridae and Charitometridae were diagnosed:

Oceanometra (genotype *Thalassometra gigantea* A. H. Clark, 1908).
Crossometra (genotype *Pachylometra investigatoris* A. H. Clark, 1909).
Perissometra (genotype *Antedon flexilis* P. H. Carpenter, 1888).
Monachometra (genotype *Pachylometra fragilis* A. H. Clark, 1912).
Calyptometra (genotype *Charitometra lateralis* A. H. Clark, 1908).
Chondrometra (genotype *Chlorometra robusta* A. H. Clark, 1911).

A complete revision of the family Antedonidae appeared on March 4, 1917, in which the following subfamilies were recognized:

Antedoninae (including *Antedon*, *Compsometra*, *Mastigometra*, *Euantedon*, *Toxometra*, *Dorometra*, *Eumetra*, *Iridometra*, *Hybometra*, *Andrometra*, and *Argyrometra*).

Thysanometrinae (including *Thysanometra* and *Coccometra*).

Perometrinae (including *Perometra*, *Nanometra*, *Erythrometra*, and *Hypalometra*).

Heliometrinae (including *Heliometra*, *Promachocrinus*, *Anthometra*, *Solanometra*, *Florometra*, and *Cyclometra*).

Zenometrinae (including *Balanometra*, *Psathyrometra*, *Leptometra*, *Adelometra*, *Zenometra*, *Sarametra*, and *Eumorphometra*).

Isometrinae (including *Isometra*).

Bathymetrinae (including *Orthometra*, *Tonrometra*, *Fariometra*, *Trichometra*, *Hathrometra*, *Nepiometra*, *Phrixometra*, *Thaumatometra*, and *Bathymetra*).

Of the 40 genera assigned to the Antedonidae the following 9 were new:

Dorometra (genotype *Antedon nana* Hartlaub, 1890).
Andrometra (genotype *Antedon psyche* A. H. Clark, 1908).
Argyrometra (genotype *Iridometra crispa* A. H. Clark, 1908).
Sarametra (genotype *Zenometra triserialis* A. H. Clark, 1908).
Orthometra (genotype *Trichometra hibernica* A. H. Clark, 1913).
Tonrometra (genotype *Antedon remota* P. H. Carpenter, 1888).
Fariometra (genotype *Trichometra explicata* A. H. Clark, 1908).
Nepiometra (genotype *Antedon laevis* P. H. Carpenter, 1888).
Phrixometra (genotype *Antedon longipinna* P. H. Carpenter, 1888).

A new species was described, the second known from New Zealand:

Argyrometra mortenseni.

On March 31 four new echinoderms from the West Indies were described, among them two crinoids:

Neocomatella ornata.
Nemaster insolitus.

On June 19 the family Bourgueticrinidae was revised, according to the plan indicated in the memoir on the crinoids of the Antarctic regions. The following new genus was described:

Monachocrinus (genotype *Monachocrinus sexradiatus*, sp. nov.).

The following new species was described:

Monachocrinus sexradiatus.

Detailed keys to the subfamilies and genera of the family Antedonidae were published on October 4, and on May 16 in two separate papers a new Philippine comatulid, *Prometra longipinna*, was described, and the crinoid fauna of New Zealand and Tasmania was discussed.

From New Zealand the following species were listed:

Comanthus benhami A. H. Clark.
Comanthus novaezealandiae, sp. nov.
Argyrometra mortenseni A. H. Clark.

and from Tasmania the following were given:

Comanthus tasmaniae.
Comanthus plectrophorum.
Comissia spanoschistum.
Austrometra thetidis.
Ptilometra macronema.
Cosmiometra dasybrachia.
Compsometra incommoda.
Metacrinus cyaneus.

Comanthus novaezealandiae and *Comanthus tasmaniae* were described in detail.

The classification of the comatulids was presented in full for the first time in the memoir on the unstalked crinoids of the *Siboga* expedition published in March, 1918, and that of the stalked types was brought practically into its final form by a short paper published on March 4, 1919, in which *Holopus* was shown to be closely related to the pentacrinites and to the comatulids.

Since the publication of the *Siboga* report there have been no changes in the classification of the comatulids by the present author.

In 1917 Dr. Th. Mortensen published a preliminary description of a remarkable new genus and species of comatulid from the Antarctic which he called *Notocrinus virilis*. This was described in much greater detail in 1918, when it was made the type of a new family, the Notocrinidae. Together with *Notocrinus virilis*, Mortensen described *Isometra vivipara*, and in his later memoir he added *Thaumatometra nutrix*.

In 1922 Dr. Torsten Gislén published a very extensive work on the crinoids collected by Dr. Sixten Bock in the Bonin Islands and Japan. In this there were described two new genera, *Didontometra* and *Clarkometra*, and the following new species:

Comatella brachycirra.
Comissia peregrina var. *magnifica.*
Comissia ignota var. *minuta.*
Comaster delicata var. *grandis.*
Comantheria grandicalyx var. *flagellipinna.*
Comanthus parvicirra f. *comasteripinna.*
Comanthus parvicirra f. *comanthipinna.*
Catoptometra magnifica var. *minor.*
Eudiocrinus gracilis var. *pulchellus.*
Eudiocrinus lovéni.
Cyllometra pulchella.
Stenometra dentata.
Perissometra aranea.
Didontometra bocki.
Toxometra aequipinna.
Psathyrometra wireni.
Clarkometra elegans.
Metacrinus nobilis var. *tenuis.*
Metacrinus interruptus f. *ornatus.*

In January, 1923, the present author published a revision of the recent representatives of the family Pentacrinidae, none of which were found to be congeneric with fossil forms. The genera accepted are:

Metacrinus (genotype *Metacrinus wyvillii* P. H. Carpenter, 1884).

Saracrinus (genotype *Metacrinus nobilis* P. H. Carpenter, 1884).

Cenocrinus (genotype *Pentacrinites caput-medusae* Miller, 1821 = *Encrinus caput-medusae* Lamarck, 1816 = *Isis asteria* Linné, 1766).

Teliocrinus (genotype *Teliocrinus asper* Döderlein, 1912 = *Hypalocrinus springeri* A. H. Clark, 1909; this species is also the type of *Comastrocrinus* A. H. C. described later in the same year).

Endoxocrinus (genotype *Encrinus parrae* Gervais, 1835 = *Encrinus milleri* Guilding, 1828 [not *Encrinites milleri* von Schlotheim,1822] = *Pentacrinus mülleri* Oersted, 1856).

Diplocrinus (genotype *Pentacrinus maclearanus* Wyville Thomson, 1877 [here designated]).

Annacrinus (genotype *Pentacrinus wyville-thomsoni* [Jeffreys, *nomen nudum*] Wyville Thomson, 1872).

Neocrinus (genotype *Pentacrinus decorus* Wyville Thomson, 1864).

Hypalocrinus (genotype *Pentacrinus naresianus* P. H. Carpenter, 1882).

In 1925 Dr. Torsten Gislén described a new genus, *Porphyrocrinus*, including the single species *P. verrucosus*, in the family Phrynocrinidae, for which family he gave an emended diagnosis. In the same paper he described *Democrinus globularis*.

In 1927 Doctor Gislén published a very important memoir on the crinoids collected by Dr. Th. Mortensen in Japanese waters in 1914–1916, in which the following new species appeared:

Comanthus parvicirra f. *vaniipinna*.
Perissometra carinata.
Prometra perplexa.
Monachometra mortenseni.
Democrinus braueri var. *japonicus*.

Since the completion of volume 1 Doctor Gislén has published [1] a most important work dealing with the recent crinoids from almost every point of view and bringing out an extraordinary amount of new information.

Much of this work is devoted to a critical discussion of Parts 1 and 2 of Volume 1, and in several instances he takes issue with my conclusions, always on the basis of an exhaustive study of a large amount of new material.

As we have each stated our case fully, there is nothing to be gained by restatement. The relative merits of our respective positions will be determined by subsequent workers.

The only matter which need be considered here is his suggested classification of the recent comatulids.

The recent comatulids I had grouped in two suborders, the Oligophreata and the Macrophreata, which are abundantly distinct. Gislén suggested that they should be grouped not in two but in four natural groups or tribes of equal value. His classification is as follows:

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[1] Echinoderm Studies. Zoologiska Bidrag från Uppsala [Zoologische Beiträge aus Uppsala], vol. 9, 1924.

(1) Tribe Comasterida (Comasteridae only).
(2) Tribe Mariametrida (Zygometridae, Himerometridae, Mariametridae, Stephanometridae, Tropiometridae, and Colobometridae).
(3) Tribe Thalassometrida:
  (*a*) Subtribe Thalassometrida (Thalassometridae, Charitometridae, and Calometridae).
  (*b*) Subtribe Notocrinida—
    1. Section including the Notocrinidae.
    2. Section including the Asterometridae, new family (*Asterometra* and *Pterometra*).
(4) Tribe Macrophreata:
  (*a*) Group including forms with the centrodorsal more or less hemispherical, rarely discoidal, and its internal cavity rather moderate; cirri arranged in alternating rows (Antedoninae, Perometrinae, and perhaps also *Thaumatocrinus*).
  (*b*) Group including forms with the centrodorsal conical to columnar and its internal cavity excessively large; cirri in columns, or tending toward columns (Zenometrinae, Bathymetrinae, Heliometrinae, ?*Comatonia*, Isometrinae, Atelecrinidae, and Pentametrocrinidae [perhaps excluding *Thaumatocrinus*]).

Doctor Gislén suggested that the subfamily Perometrinae was possibly developed from the Colobometridae in the direction of the Macrophreata. He also remarked that *Comatonia* differs from all other comasterids in having a rounded-conical centrodorsal with the cirri in 3 or 4 rows and strong synarthrial processes, as well as in the possession of sacculi. He gave it as his opinion that *Comatonia* is a macrophreate form possibly related to the Heliometrinae.

Gislén's discussion of the groups of recent comatulids established by him is as follows:

(1) Comasterida. Centrodorsal discoidal. Centrodorsal cavity (excepting in small forms, as for instance *Comatilia*) small and shallow. Cirri often rudimentary or lacking, rarely more than a double row, the rows almost always alternating (the exception being *Palaeocomatella*). Cirrus sockets without sculpture. Basal star sometimes developed. Articular faces of the radials vertical. Radial cavity large, filled by a large central calcareous plug. Muscular fossae on the articular faces of the radials very low broad bands. Arms 10 or more. Number of the elements in the division series in the multibrachiate forms often very variable in closely related groups, as well as in different rays of the same individual. Synarthries weakly developed, often replaced by cryptosynarthries, pseudosyzygies, or syzygies. No synarthrial tubercle or synarthrial backward projection. Many syzygial septa (except in small forms). Syzygies usually numerous. Covering plates in *Nemaster* and *Comatilia*. Pear-shaped organs instead of sacculi. The proximal and sometimes the distal pinnules also with a comb (combs elsewhere occurring, in rudimentary form, only in the Heliometrinae). P_1 the longest proximal pinnule, the succeeding pinnules decreasing in length regularly. Distal pinnules with strong hooks on the most distal segments. Disk often exocyclic, sometimes with calcareous granules.

Genital glands especially well developed in the posterior arms. Creeping forms (see vol. 1, pt. 2, pp. 596 and 602 and following). The only family included in this group is the Comasteridae.

(2) Mariametrida. Centrodorsal more or less distinctly discoidal, very rarely a low hemisphere. Centrodorsal cavity generally small and shallow. Radial coelomic processes usually extending between the centrodorsal and the radials, lying in shallow depressions or meandering grooves. Cirri (as in the following groups) always well developed. Cirrus sockets sometimes with an areola, otherwise without sculpture, rarely in more than two alternating rows. Seldom any basal star. Basals rarely protruding. Radial cavity large to moderate, usually filled by a central plug. Muscular fossae on the articular faces of the radials of moderate size, sometimes very reduced or even lacking. Synarthries usually well developed, only in the Zygometridae partly replaced by syzygies. Arms generally more than 10. Number of elements in the division series most frequently fixed (except in the Zygometridae and Himerometridae). No synarthrial backward projections. Synarthrial tubercules in some of the Himerometridae. Syzygial septa numerous (except in small forms). Syzygies occurring at rather long intervals on the arms. No side or covering plates. Sacculi present in this and all the following groups. No terminal combs. Proximal pinnules in the Zygometridae, certain Himerometridae, and the Mariametridae of about the same length and unmodified; in the other families one or more pinnules are distinguished by their length, thickness, or stiffness. Distal segments of the pinnules in this and the following groups without hooks, or with rudimentary ones only. Disk, as in the following groups, always endocyclic, rarely with calcareous granules (*Mariametra*). Swimming forms. The following groups are included: Zygometridae, Himerometridae, Mariametridae, Stephanometridae, Tropiometridae, and Colobometridae.

(3) Thalassometrida. Centrodorsal conical to discoidal, very variable. Centrodorsal cavity rather deep. Cirri usually in columns. Cirrus sockets often somewhat sculptured (in contrast to all other comatulids except the Atelecrinidae). Generally a basal star. Basals often protruding at the interradial angles. Muscular fossae on the articular faces of the radials rather large, often narrow and high and bent at an angle with the rest of the face. Radial cavity usually of medium size or small. Calcareous plug inconspicuous or lacking. Arms usually wall-sided, and between 10 and 20 in number. Number of elements in the division series rather fixed (except in *Crinometra*). Synarthries well developed. Sometimes a synarthrial backward projection. Syzygial septa rather few. Interval between the syzygies variable. Side and covering plates well developed. Arms usually laterally flattened distally, in cross section triangular. The ends of the arms terminate abruptly with from 5 to 7 segments supporting rudimentary pinnules (in contrast to all other comatulids). Proximal pinnules insignificantly specialized. Pinnule segments usually rectangular or pronouncedly triangular (in contrast to all other comatulids). Disk often covered with calcareous plates or granules.

(*a*) Thalassometrida, in the restricted sense. No radial pits. Articular facets of the synarthries narrow, occupying only a part of the synarthrial face. Thalassometridae, Charitometridae, and Calometridae.

(*b*) Notocrinida. Deep radial pits. Articular facets occupying almost the whole of the synarthrial face.

(1) Side and covering plates moderate. Brachials and pinnules rounded. Genital glands in the arms. Notocrinidae.

(2) Side and covering plates well developed. Brachials and pinnule segments prismatic—triangular in cross section. Genital glands in the pinnules. Asterometridae, new family (including *Asterometra* and *Pterometra*).

(4) Macrophreata. Centrodorsal conical, hemispherical, or, rarely, discoidal. Centrodorsal cavity large and deep. Basal star generally reduced (Atelecrinidae with large basals). Muscular fossae on the articular faces of the radials very large, equal to or larger than the rest of the face (relatively smallest in the Antedoninae). No calcareous plug. Synarthrial backward projection present. Syzygies numerous, with few septa (except in the largest forms). Arms 10 with very rare exceptions. Side and covering plates strongly reduced (largest in the Heliometrinae). Proximal pinnules strongly polymorphous and differentiated.

(*a*) Centrodorsal more or less hemispherical (rarely discoidal as in *Eumetra* and other genera). Centrodorsal cavity rather moderate. Cirri in alternating rows. Synarthrial backward projection moderate. Articular facets of the synarthries occupy almost the whole of the synarthrial face. Antedoninae, Perometrinae, Thysanometrinae, and perhaps also *Thaumatocrinus*.

(*b*) Centrodorsal conical to columnar. Centrodorsal cavity excessively large. Cirri in columns, or tending to be arranged in columns. Synarthrial backward projections generally very large. Articular facets narrow, occupying a part of the synarthrial face only. Zenometrinae, Bathymetrinae, Heliometrinae, *?Comatonia*, Isometrinae, Atelecrinidae, Pentametrocrinidae (perhaps excluding *Thaumatocrinus*).

This rearrangement of the comatulid types was based so far as possible upon characters which can be determined in fossil species, especially, therefore, characters which are evident in the centrodorsal and in the radials. Altogether too little weight is given to the characters furnished by the arms and pinnules.

Structurally the pinnules are the most distinctive organs of the comatulids and the organs showing the widest departure from the conditions in the other crinoid types. Among the comatulids the pinnules serve as food-gathering organs, as appendages containing the genital organs, as locomotor organs used for crawling or collectively as a web or vane in swimming, as tendrillike grasping organs supplementing the cirri, as pectinate cleaning organs, as sensitive tactile organs, and as spinelike organs of defense. When serving for purposes other than the collection of food they usually lack ambulacral structures. In some cases the enlarged proximal segments of the oral pinnules are embedded in the dorsal perisome and form part of the body wall, as in many other crinoids.

Since the extraordinary diversification of the pinnules is the chief distinguishing feature of the comatulids as compared with other crinoids, it is in the pinnules that we find the most abundant and the most definite clues to their true interrelationships. The structure of the centrodorsal and of the radial pentagon is of the greatest value in showing the more fundamental lines of departure from the generalized type, and in serving as a check on conclusions based mainly on the study of the arms and pinnules.

When attempts are made to overemphasize the systematic importance of the characters presented by the proximal structures difficulties at once arise. The proximal structures of all the comatulids are so very much alike that misinterpretations due to parallelism, convergence, or superficial similarity are very difficult to avoid. An example of this is seen in *Ptilometra australis* in which the articular faces of the radials (vol. 1, pt. 2, fig. 67, p. 43; pl. 2, figs. 973, 974) are very different in appearance from those of *Asterometra macropoda* (vol. 1, pt. 2, figs. 69, 70, p. 43), while the cirri, arms, and pinnules in the two types are very similar. In small comatulids, also, the articular faces of the radials may differ very widely in general appearance from those of larger species in the same group. For instance, the articular faces of the radials in *Comatilia iridometriformis* (vol. 1, pt. 2, figs. 13, 14, p. 15) or in *Leptonemaster venustus* (vol. 1, pt. 2, figs. 11, 12, p. 6) are, superficially at least, very different from those of *Comatella nigra* (vol. 1, pt. 2, figs. 1, 2, p. 6) or *Capillaster sentosa* (vol. 1, pt. 2, figs. 5, 6, p. 6).

Gislén's first three groups, while quite distinct from each other, possess certain features in common (see the keys following) by which they are separated from the fourth group. It is most logical, therefore, to continue to regard them as forming a single group, the Oligophreata, corresponding to his fourth group, the Macrophreta.

I can see no reason whatever for excluding *Comatonia* from the Comasteridae, as it possesses an enormous and typically comasterid comb. The comb is the only structure not subject to wide and disconcerting modifications in this family.

The family Tropiometridae is quite out of place in the Mariametrida. Its prismatic pinnules, the abrupt termination of the arm tips, and the almost unmodified proximal pinnules emphatically indicate a relationship with the forms included in the Thalassometrida, especially with the Ptilometrinae, while the centrodorsal resembles that of *Ptilometra* and also those of certain of the Charitometridae, and the cirri recall the cirri of various members of the Charitometridae.

I can see no reason at all for including the Notocrinidae in the Thalassometrida. Its arm and pinnule structure is certainly that of a macrophreate type, and moreover all of the other comatulids with anomalous reproductive organs or habits are macrophreate forms.

Gislén's family Asterometridae seems to be the same as my subfamily Ptilometrinae of the Thalassometridae, but he does not say whether *Ptilometra* is included in it; in fact, he does not mention *Ptilometra* at all. Though fairly well developed, the side and covering plates in this group are certainly not very highly developed.

It is difficult to see any reason for Gislén's division of the Macrophreata. The Heliometrinae and Bathymetrinae are certainly much more closely allied to the Perometrinae than they are to the Atelecrinidae or to the Pentametrocrinidae, while the genera *Pentametrocrinus* and *Thaumatocrinus*, making up the family Pentametrocrinidae, are certainly much more closely allied to each other than they are to any other forms.

The following arrangement of the recent comatulids is adopted herein:

- Order Comatulida:
  - Suborder Oligophreata—
    - Superfamily Comasterida—
      - Family Comasteridae—
        - Subfamily Capillasterinae.
        - Subfamily Comactiniinae.
        - Subfamily Comasterinae.
    - Superfamily Mariametrida—
      - Family Zygometridae.
      - Family Eudiocrinidae.
      - Family Himerometridae.
      - Family Mariametridae.
      - Family Colobometridae.
    - Superfamily Tropiometrida—
      - Family Tropiometridae.
      - Family Calometridae.
      - Family Thalassometridae—
        - Subfamily Ptilometrinae.
        - Subfamily Thalassometrinae.
      - Family Charitometridae.
  - Suborder Macrophreata—
    - Family Antedonidae—
      - Subfamily Antedoninae.
      - Subfamily Thysanometrinae.
      - Subfamily Perometrinae.
      - Subfamily Zenometrinae.
      - Subfamily Heliometrinae.
      - Subfamily Bathymetrinae.
    - Family Notocrinidae.
    - Family Pentametrocrinidae.
    - Family Atelecrinidae.

PRESERVATION OF SPECIMENS

As a result of his long experience at the Naples Station, Dr. Salvatore Lo Bianco found that *Antedon* may be satisfactorily preserved by direct immersion in 70 per cent alcohol. *Leptometra*, however, on account of its greater tendency to autotomy, must be killed in 90 per cent alcohol. The vessel should be shaken vigorously in order to hasten death and to prevent the animals from breaking off their arms. When there is doubt about the species 90 per cent alcohol should be used.

Pentacrinoids should first be narcotized with one-tenth of 1 per cent chloral hydrate, a process requiring from two to four hours. If they are then hardened in alcohol they will remain with the arms perfectly distended. The more advanced stages are best killed with saturated sublimate; but they should remain only for a few moments in this solution in order to avoid damage to the skeletal structures.

Dr. H. L. Clark found it very easy to prepare perfectly expanded specimens of the comatulids which he found at Maer Island in Torres Straits. They were lifted from the sea water, with the cirri down, and plunged abruptly into strong alcohol in a shallow, flat dish, care being taken to press the central portion down at once to the bottom of the dish. The contraction of the dorsal ligaments causes the arms to lie out flat against the bottom of the dish. The following contraction of the ventral muscles is occasionally strong enough to bring the arms up over the disk and to get them badly entangled, but in the very great majority of cases it is so feeble and so quickly followed by relaxation that a little manipulation of the arms, smoothing them down with the fingers and pressing out the curves, results in perfectly expanded specimens.

IDENTIFICATION OF COMATULIDS

The comatulids are exceptionally difficult animals to identify. Many of them are very variable, so variable that different individuals may present a widely different aspect. This is especially true in those species in which the number of arms varies between wide extremes, in which the number of elements in the division series is subject to much variation, and in which the arms vary very greatly in relative length. It is particularly true in the comasterids.

It not infrequently happens that two comasterids with the same number of arms belonging to species of different genera will resemble each other more closely than either resembles others of its own species with a different number of arms.

In those groups in which the majority of the species have numerous arms and distinctive division series the species with 10 arms are often confusing. This is especially true in the comasterids, in which we are accustomed to give great weight to the characters offered by the division series and in which, therefore, the differences in the cirri, pinnules, and other structures, though constant, seem at first sight to be trivial and unimportant.

The difficulties attending the determination of the comatulids are greatly increased by the fact that practically all specimens examined are more or less extensively mutilated.

In identifying comatulids, therefore, it is necessary to follow the keys very closely and literally. The short cuts, which can be used successfully in the case of nearly all other creatures, are likely to lead one astray in the case of the comatulids. The general appearance especially is deceptive.

TREATMENT OF THE SPECIES

At the head of the account of each species is an annotated list of references including all the works which the author has consulted. These references cover not only the synonymy and distribution, but also the historical, anatomical, and other aspects of the study of these animals which were included in Parts 1 and 2 of Volume 1. All of the references have been personally verified.

Following the references is a brief summary of the essential characters which serve to distinguish the species from closely related types, and sometimes also from types not closely related but superficially very similar.

The great majority of the comatulids are so very variable both individually and locally that a description of a species which would include mention of all the common deviations from what in the light of our present knowledge seems to be the typical form would be quite impracticable, and not only impracticable but also almost hopelessly confusing.

The descriptions are therefore drawn up from a representative specimen or several specimens and are followed by notes taken from other individuals.

The specimens on which notes are given are arranged in geographical sequence corresponding with the sequence in the list of localities following so that local variations and local peculiarities, where such exist, may be readily appreciated.

The localities are all arranged in a definite order from one extreme of the range to the other. When a locality has already been published the fact is indicated by the name of the author and the date of publication in brackets. All the localities have been verified, and in most cases much more information regarding the localities is given herein than was given in the original record. If the present author has examined the material upon which a locality record is based, the number of specimens seen by him and their present location is given in parentheses.

In the case of all species which have been known for a considerable period a short history is appended in order to make their status clear.

Order COMATULIDA A. H. Clark

Comatulida A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (ordinal name suggested to cover the recent comatulids and their fossil relatives, including *Uintacrinus*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 209 (internal classification); pp. 276, 277 (used as an ordinal name covering all comatulids); vol. 35, 1908, p. 120 (used as an ordinal name covering all comatulids); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 174 (divided into Comatulida Innatantes, Comatulida Oligophreata, and Comatulida Macrophreata); Proc. U. S. Nat. Mus., vol. 38, 1910, p. 115 (systematic position); p. 116 (includes Comatulida and Pentacrinitidae; phylogenetic position); p. 117 (division into 2 groups, Comatulida and Pentacrinitidae; phylogenetic history); p. 118 (development of the calyx); p. 214 (history; significance of the loss of the larval column); vol. 40, 1911, p. 6 (45 species representing 7 families on the African coasts); Crinoids of the Indian Ocean, 1912, p. 43 (key to the suborders); p. 288 (of Bather, 1898; on the coral reefs at Blaking Mati "the most striking forms are numberless Antedonidae"); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range; phylogenetic and paleontological significance); Die Crinoiden der Antarktis, 1915, p. 110 (diagnosis; geological, geographical, bathymetrical, and thermal ranges); Amer. Jour. of Science, vol. 40, 1915, p. 62 (dominant section of the Pentacrinitidae in the recent seas); p. 67 (detailed discussion of the bathymetrical range); Smithsonian Miscell. Coll., vol. 65, No. 10, 1915, pp. 9 and following (phylogenetical study).

Comatulids Springer and Clark, Zittel-Eastman's Paleontology, 1913, p. 228 (phylogenetic definition); p. 234 (diagnosis and relationships).

Diagnosis.—Pentacrinites in which basals, usually but not always metamorphosed into a rosette, are present, and the column is either entirely absent, or is discarded after the formation of the first nodal columnal which remains permanently attached to the calyx.

Geographical range.—Occurring in all oceans and seas, excepting the Black Sea and the Baltic.

Bathymetrical range.—From between tide marks down to 5,301 meters.

Thermal range.—From the very warm waters of the intertidal zone of the Tropics down to −1.85° C.

Remarks.—It is not difficult to draw up a systematic arrangement for the recent crinoids which is quite satisfactory when recent forms only are considered. But as soon as an attempt is made to harmonize such a classification with a classification based on the numerous fossil types difficulties at once appear. For the comatulids are in reality only a single minor offshoot from the pentacrinite stem which in the recent seas has become so enormously diversified as to represent in itself alone a whole order with well circumscribed suborders and minor divisions.

The comatulids furnish one of the best examples of a small and insignificant twig from a side branch of a phylogenetic tree suddenly becoming the main branch and developing intricate ramifications in the nature of branchlets, twigs, and minor divisions which almost completely obscure what appeared to be, in the past, the important branches.

The late Mr. Frank Springer and I, at the request of the late Dr. Charles R. Eastman, prepared the section on the Crinoidea for the edition of Zittel-Eastman's

Paleontology which was published in 1913. In this we correlated the classification of the recent forms which I had previously worked out on the basis of living material alone with the currently accepted classification of the fossil types. The systematic scheme which we adopted is given in the introduction on page 53.

KEY TO THE FAMILIES AND HIGHER GROUPS OF THE COMATULIDS

a^1. Cavity in the centrodorsal containing the chambered organ and overlying structures very small and shallow; rosette sunk below the dorsal surface of the radial pentagon, and with both the radial and interradial processes forming "spoutlike" processes; central portion of the radial pentagon more or less completely filled with irregular calcareous deposit which forms a central plug; plane of the muscular fossae on the radial articular faces making a considerable angle with the dorsoventral axis, or the muscular fossae very greatly reduced; joint face elements distal to the transverse ridge not at all, or only slightly, excavated interiorly; brachials from about the fourteenth onward short, usually much broader than long; second syzygy in the arms beyond the ninth brachial; brachial syzygies usually more or less widely and irregularly spaced; pinnules, at least the proximal, wholly or in part prismatic, with a dorsal carination, which may be confined to the earlier segments; segments of the distal pinnules beyond the third not especially slender or elongated, and the first 2 not appreciably broadened; never more than 5 radials; arms very commonly more than 10 (of general occurrence, but absent from the Arctic regions and the north Atlantic north of the Bay of Biscay and North Carolina, the Mediterranean Sea, the west coast of North and South America, the Bering and Okhotsk Seas and all but the southeastern portion of the Sea of Japan, and the shores of the Antarctic Continent; littoral to abyssal) -------------- **Oligophreata**, p. 74.

b^1. Lowest pinnules with a comblike structure at the tip; mouth usually more or less marginal, and anal tube usually more or less central; sacculi very rarely present (Japan and Polynesia to New Zealand and Tasmania, westward to the whole east coast of Africa; northwestern Africa and southwestern Europe; North Carolina to Brazil; chiefly littoral and sublittoral, but a few species are found in fairly deep water).
Comasterida; **Comasteridae**, p. 76.

c^1. Cirri present.

d^1. Arms 10 or more; if the arms are more than 10, the first brachial syzygy is between brachials 1+2 or 2+3.

e^1. Cirri with dorsal spines or tubercles on the outer segments; division series all 2, or the IIBr series 4 (3+4), exceptionally 2, and the following series 3 (2+3); genital pinnules not especially stout, the component segments not noticeably short (Japan and Polynesia to Tasmania and westward to east Africa; northwestern Africa and the Bay of Biscay; North Carolina to Brazil; chiefly littoral and sublittoral, but in the Atlantic found also in fairly deep water) -------------------------- **Capillasterinae**, p. 85.

e^2. Outer cirrus segments entirely without dorsal spines or tubercles; IIBr and IIIBr series, if present, 2 (1+2); genital pinnules usually composed of relatively short and broad segments (southwestern Japan to southern Australia and westward to the Andaman Islands; North Carolina to Brazil; chiefly littoral, but a few species are found in fairly deep water) ------------------------------ **Comactiniinae**, p. 293.

d^2. Always more than 10 arms; first brachial syzygy between brachials 3+4 (Japan and Polynesia to New Zealand and Tasmania, and westward to Madagascar and South Africa; littoral and sublittoral) ---------------------------- **Comasterinae**, p. 404.

c^2. No cirri.

d^1. First brachial of the free undivided arms bearing the first pinnule; first syzygy between brachials 2+3; IIBr series 4 (3+4) and following division series 3 (2+3) (China Sea to Borneo; littoral and sublittoral) ---------------------------- **Capillasterinae**, p. 85.

d^2. Second brachial of the free undivided arms bearing the first pinnule; a syzygy between brachials 3+4, sometimes also between brachials 1+2, but never between brachials 2+3; division series never 3 (2+3).

e^1. Arms 10 or more; all the division series 2 (1+2); genital pinnules composed of short and very broad segments (Burma and the Andaman Islands to tropical Australia; littoral) ---------- **Comactiniinae, p. 293.**

e^2. Always more than 10 arms; at least some, and occasionally all, of the division series of 4 elements; genital pinnules unmodified (Polynesia and the Philippines to tropical Australia, and westward to the Maldives; littoral) ---------- **Comasterinae, p. 404.**

b^2. No comblike structure on the lowest pinnules; mouth always central or subcentral, and anal tube more or less marginal; sacculi always present, though sometimes in small numbers.

c^1. Only the oral pinnules prismatic, and these often keeled only at the base (Japan and Polynesia to Tasmania and westward to east and south Africa; Caribbean Sea; littoral and sublittoral) ---------- **Mariametrida (pt. 4).**

d^1. Cirrus segments either without dorsal processes, or the distal each with a median carination or carinate spine.

e^1. Arms 5 in number, no axillaries being present (Japan to the Moluccas and the Lesser Sunda and Andaman Islands; sublittoral) ---------- **Eudiocrinidae (pt. 4).**

e^2. Arms 10 or more, the second postradial ossicle being always axillary.

f^1. Elements of the IBr series united by syzygy (Japan to tropical Australia and westward to Ceylon; littoral and sublittoral) ---------- **Zygometridae (pt. 4).**

f^2. Elements of the IBr series not united by syzygy, but by synarthry.

g^1. Arms 10 or more; if there are more than 10 arms the IIBr series are 4 (3+4) (Japan and Polynesia to tropical Australia, and westward to east Africa; littoral and sublittoral) ---------- **Himerometridae (pt. 4).**

g^2. Always more than 10 arms; all the division series 2 (Japan and Polynesia to tropical Australia, westward to east Africa; littoral and sublittoral).
Mariametridae (pt. 4).

d^2. Middle, and almost invariably also the outer, cirrus segments each with a pair of dorsal spines or tubercles, one on either side of the median line (Japan and Polynesia to Australia, westward to east Africa; Caribbean Sea; littoral and sublittoral).
Colobometridae (pt. 4).

c^2. All of the pinnules prismatic with a sharp, or sharply rounded, dorsal keel (Japan, Aleutian, Hawaiian, and Galápagos Islands to Tasmania and westward to east and south Africa; in the Atlantic north to the Bay of Biscay and the Caribbean Sea; chiefly in deep water and sublittoral, but a few species are littoral) ---------- **Tropiometrida (pt. 4).**

d^1. Ventral perisome of the pinnules not protected by conspicuous side and covering plates; cirri stout, without dorsal processes; 10 arms (Japan and Polynesia to tropical Australia, and westward to east and south Africa; St. Helena; Caribbean Sea to Brazil; chiefly littoral, but in the Caribbean Sea occurring in rather deep water).
Tropiometridae (pt. 4).

d^2. Ventral surface of the pinnules protected by conspicuous side and covering plates easily visible with a hand lens.

e^1. P_1 very delicate, flexible and weak, with the first 2 segments enormously enlarged and the remainder very small and about as long as broad; P_2 and usually also some of the following pinnules much elongated, enlarged and stiffened, composed of much elongated segments; disk globose, compact, entirely inclosed by a complete pavement of plates and readily detached (Japan and Polynesia to tropical Australia and the Bay of Bengal; sublittoral) ---------- **Calometridae (pt. 4).**

e^2. P_1 not delicate nor weak, its first 2 segments not noticeably enlarged; P_2 like P_3 or, more rarely, like P_1, never especially distinguished; disk sunken within the division series, with the ventral surface concave, flat, or slightly convex, and thickly beset with isolated plates.

f^1. Cirri usually long and slender, rarely of moderate length and rather stout, composed of usually more than 25 segments, of which the distal are much shorter than the proximal, broader than long, with conspicuous dorsal spines or carinate processes; surface of the shorter distal segments always light in color and highly polished; a well-marked transition segment usually present ---------- **Thalassometridae (pt. 4).**

g^1. P_1 similar to P_2, but shorter; cirri exceedingly long (Japan to Tasmania and southern Australia, westward to the Bay of Bengal; sublittoral, in south Australia also littoral) ---------------------------------- **Ptilometrinae** (pt. 4).

g^2. P_1 stouter and longer than P_2, though sometimes not much so (Japan, Aleutian, Hawaiian, and Galápagos Islands to Tasmania, and westward to east Africa; in the Atlantic north to the Bay of Biscay and the Caribbean Sea; chiefly in deep water, but a few species are sublittoral) -------- **Thalassometrinae** (pt. 4).

f^2. Cirri usually short, stout, and strongly curved, rarely more or less elongated, composed of usually fewer than 25 segments, of which the distal are little, if any, shorter than the proximal and bear no dorsal processes, or at most a low blunt tubercle at the distal end; surface of all the cirrus segments uniform in color and dull; no transition segment; P_1 more slender than the succeeding pinnules, and composed of shorter segments; P_2 usually more nearly like P_1 than like P_3 (Japan to the Kermadecs and westward to east and south Africa; Caribbean Sea; sublittoral to abyssal) ----------------------------------- **Charitometridae** (pt. 4).

a^2. Cavity in the centrodorsal containing the chambered organ and overlying structures large and deep; rosette nearly or quite on a level with the dorsal surface of the radial pentagon, or the basals, more or less reduced but not modified into a rosette, forming a ring between the centrodorsal and the radials; only the interradial processes of the rosette form "spoutlike" processes; central portion of the radial pentagon entirely open, with no calcareous deposit; plane of the muscular fossae on the radial articular faces nearly or quite parallel with the dorsoventral axis; joint face elements distal to the transverse ridge strongly excavated, so that they meet in the median line at an angle of about 90°; brachials from about the fourteenth onward usually about as long as broad, and often longer than broad, very rarely broader than long; second syzygy in the arms between brachials 9+10 or earlier; brachial syzygies close together and regularly spaced; pinnules never prismatic; segments of the pinnules beyond the third slender and usually much elongated, and the first 2 broadened; radials sometimes 10; arms very exceptionally more than 10 (occurring in all seas from the shore line to the greatest depths) -- **Macrophreata** (pt. 5).

b^1. Cirrus sockets with the borders unmodified; first syzygial pair oblong or squarish or slightly wedge-shaped, and the brachials immediately following more or less oblong.

c^1. Gonads developed wholly on the pinnules as fusiform or ovoid masses.

d^1. Second postradial ossicle always axillary (occurring in all seas from the shore line to the greatest depths) -- **Antedonidae** (pt. 5).

d^2. No axillaries, each radial being followed by an undivided series of brachials (of general occurrence, but absent from the Arctic and north and east Pacific; sublittoral to abyssal, but chiefly in deep water) ----------------------------- **Pentametrocrinidae** (pt. 5).

c^2. Gonads lying on the arms at the base of the pinnules (shores of the Antarctic Continent and immediately adjacent regions; shallow to moderately deep water) - **Notocrinidae** (pt. 5).

b^2. Cirrus sockets bordered ventrally by a horseshoe-shaped ridge, or flanked on either side by a high angular process; first syzygial pair very obliquely wedge-shaped, and the immediately following brachials triangular (Japan and Polynesia to the Indian Ocean; Brazil to the Caribbean Sea; northeast Atlantic; deep water) ------------------ **Atelecrinidae** (pt. 5).

ARTIFICIAL KEY TO THE FAMILIES OF THE COMATULIDS

a^1. Five arms only.

b^1. Centrodorsal low, much broader than high, thick discoidal or flattened hemispherical, with the cirrus sockets arranged in crowded rows; first syzygial pair oblong, or nearly so, followed by several more or less oblong brachials, which are succeeded by triangular brachials.

c^1. First 2 ossicles following the radials united by syzygy; lowest pinnule on the second ossicle following the radials and the next on the fourth, there being no pinnule on the third (vol. 1, pt. 2, fig. 127, p. 79); arms short and tapering rather rapidly; centrodorsal a thick disk (vol. 1, pt. 2, fig. 190, p. 111) (Japan to the East Indies and the Bay of Bengal; sublittoral) **Eudiocrinidae** (pt. 4).

c^2. First 2 ossicles following the radials united by synarthry; lowest pinnule on the second or fourth ossicle following the radials, and always a pinnule on the following ossicle; arms very long and slowly tapering; centrodorsal flattened hemispherical or very low conical (vol. 1, pt. 2, fig. 1016, pl. 6; fig. 1158, pl. 25) (of general occurrence, but absent from the Arctic and north and east Pacific; sublittoral to abyssal, but chiefly in deep water) **Pentametrocrinidae** (pt. 5).

b^2. Centrodorsal long conical, about as high as broad at the base, with the cirrus sockets arranged in definite columns; first syzygial pair very obliquely wedge-shaped, and the immediately succeeding brachials triangular (East Indies; deep water)-------- **Atelecrinidae** (pt. 5).

a^2. Ten or more arms.

b^1. No axillaries, each of the 10 radials bearing an undivided arm (of general occurrence, but absent from the Arctic, north and east Pacific, and west Atlantic; deep water)------------ **Pentametrocrinidae** (pt. 5).

b^2. The second ossicle following each radial is an axillary.

c^1. The lowest pinnules bear a comblike structure at the distal end (vol. 1, pt. 2, pp. 311, 319; pl. 17); mouth usually more or less near the margin of the disk, and anal tube usually more or less central (vol. 1, pt. 2, pl. 24) (Japan and Polynesia to New Zealand and Tasmania, westward to the whole east coast of Africa; northwestern Africa and southwestern Europe; North Carolina to Brazil; chiefly littoral and sublittoral, but a few species are found in fairly deep water)------------------------------- **Comasteridae**, p. 76.

c^2. No comblike structure on the lowest pinnules; mouth approximately central and anal tube more or less marginal (vol. 1, pt. 2, pp. 346, 349).

d^1. Ventral surface of the outer pinnules (as seen with a hand lens) without conspicuous plates; middle and outer pinnules not stiffened and sharply carinate.

e^1. Fourth and following brachials always bearing pinnules; first syzygial pair, composed of brachials 3+4, oblong, squarish, or slightly wedge-shaped; immediately following brachials more or less oblong; cirrus sockets never bordered ventrally by a horseshoe-shaped ridge, or flanked with high angular elevations.

f^1. Elements of the IBr series united by syzygy; usually more than 10 arms (Ceylon to north Australia and Japan; littoral and sublittoral)-------- **Zygometridae** (pt. 4).

f^2. Elements of the IBr series not united by syzygy.

g^1. Ten arms.

h^1. Brachials beyond the fourth exceedingly short, several times as broad as long, with almost or quite parallel ends.

i^1. None of the earlier pinnules enlarged; proximal and genital pinnules similar and subequal, and longer than the distal (vol. 1, pt. 2, fig. 279, p. 213), rather stout, and more or less carinate; cirri short, stout, strongly curved, and wholly without dorsal processes; brachials usually, but not always, with middorsal carinate processes (Japan and Polynesia to tropical Australia, and westward to east and south Africa; St. Helena; Caribbean Sea to Brazil; chiefly littoral, but in the Caribbean Sea occurring in rather deep water)---------------------------------- **Tropiometridae** (pt. 4).

i^2. P_3 or P_2 or both stouter and longer than the following pinnules; distal pinnules longer than the genital pinnules; genital pinnules never carinate in the outer portion; cirri slender or stout, often strongly curved, always with dorsal spines or tubercles on the distal segments; brachials never with middorsal carinate processes (vol. 1, pt. 2, pp. 115, 117) (Japan and Polynesia to tropical Australia and the Bay of Bengal; littoral and sublitoral). **Himerometridae** (pt. 4).

h^2. Brachials beyond the fourth wedge-shaped or triangular, commonly as long as broad, and never more than twice as broad as long.

i^1. Middle, and almost invariably also the outer, cirrus segments each with a pair of dorsal spines or tubercles, one on either side of the median line (Japan and Polynesia to Australia, westward to east and south Africa; Caribbean Sea; littoral and sublittoral)---------- **Colobometridae** (pt. 4).

i^2. Cirrus segments either without dorsal processes, or the distal each with a median carination or carinate spine.

j^1. Gonads developed wholly in the pinnules (vol. 1, pt. 2, figs. 281, 282, p. 215; fig. 298, p. 221; figs. 1056, 1063, 1064, pl. 14) (universal in occurrence; found at all depths)------------------------------ **Antedonidae** (pt. 5).

j^2. Gonads lying on the arms at the base of the pinnules (vol. 1, pt. 2, pl. 55) (shores of the Antarctic Continent and immediately adjacent regions; shallow to moderately deep water)--------------- **Notocrinidae** (pt. 5).

g^2. More than 10 arms.

h^1. Radials 5 in number.

i^1. Cirrus segments each with a pair of dorsal spines or tubercles, one on either side of the median line (Japan and Polynesia to Australia, westward to the Sunda Islands; littoral and sublittoral)----------- **Colobometridae** (pt. 4).

i^2. Cirrus segments without dorsal processes, or the outer each with a median carination or spine.

j^1. Centrodorsal a more or less thick disk with inwardly sloping sides and a broad bare dorsal pole; cirri marginal, and if arranged in more than one row the rows are very irregular.

k^1. IIBr series invariably 2 (vol. 1, pt. 2, figs. 125, 130, p. 79; figs. 194–197, p. 120 and following) (Japan and Polynesia to tropical Australia, westward to east Africa; littoral and sublittoral)-- **Mariametridae** (pt. 4).

k^2. Some or all of the IIBr series 4 (3+4) (vol. 1, pt. 2, fig. 123, p. 79) (Japan and Polynesia to tropical Australia, westward to east Africa; littoral and sublittoral)---------------------------- **Himerometridae** (pt. 4).

j^2. Centrodorsal conical with more or less swollen sides, bearing cirri of decreasing size to the apex; cirri arranged in definite columns or in regular alternating rows (East Indies and Madagascar; sublittoral).
Antedonidae (pt. 5).

h^2. Radials 10 in number (shores of the Antarctic Continent and immediately adjacent regions; shallow to deep water)-------------- **Antedonidae** (pt. 5).

e^2. No pinnules on the lowest 10 or 12 brachials; first syzygial pair, composed of brachials 3+4, very obliquely wedge-shaped; immediately following brachials triangular; centrodorsal conical; cirrus sockets, which are arranged in 10 or 15 columns, bordered ventrally by a horseshoe-shaped ridge or flanked by high angular elevations (Japan and Polynesia to the Indian Ocean; Caribbean Sea to Brazil; northeast Atlantic; deep water)--- **Atelecrinidae** (pt. 5).

d^2. Ventral surface of the outer pinnules protected by prominent side and covering plates easily seen with a hand lens, especially if the pinnule be dried (vol. 1, pt. 2, pp. 399, 405, 412; figs. 1166–1169, 1171, pl. 27); pinnules stiffened, with a sharp dorsal crest, triangular in cross section (vol. 1, pt. 2, fig. 659, p. 329).

e^1. P_1 very delicate, flexible and weak, with the first 2 segments enormously enlarged and the remainder very small and about as long as broad; P_2 and usually also some of the following pinnules much elongated, enlarged and stiffened, composed of much elongated segments (vol. 1, pt. 2, fig. 311, p. 223; figs. 314, 320, p. 227); disk globose, compact, entirely inclosed by a complete pavement of plates and readily detached (vol. 1, pt. 2, figs. 734–737, p. 349); color usually variegated, with the arms conspicuously and regularly banded (vol. 1, pt. 2, figs. 200–202, p. 130 and following) (Japan and Polynesia to tropical Australia and the Bay of Bengal; sublittoral).
Calometridae (pt. 4).

c^2. P_1 not delicate nor weak, with the first 2 segments not noticeably enlarged; P_2 like P_3 (vol. 1, pt. 2, fig. 280, p. 213; figs. 317, 318, p. 318), or, more rarely, like P_1 (vol. 1, pt. 2, figs, 303, 304, p. 223), never especially distinguished; disk sunken within the division series, with the ventral surface concave, flat, or slightly convex, and thickly beset with isolated plates (vol. 1, pt. 2. figs. 743–746, p. 349); color usually plain, yellow, brownish, or purplish, sometimes with the basal portion darker, seldom blotched.

f^1. Cirri usually long and slender, rarely of moderate length and rather stout, composed of usually more than 25 segments, of which the distal are much shorter than the earlier and bear conspicuous dorsal spines or carinate processes; surface of the shorter distal segments always light in color and highly polished; a well-marked transition segment usually present------------------ **Thalassometridae** (pt. 4).

g^1. P_1 stouter and longer than P_2 (vol. 1, pt. 2, figs. 283, 284, p. 215; fig. 1050, pl. 13), though sometimes not much so; color plain (vol. 1, pt. 2, figs. 210–225, p. 150 and following; fig. 1140, pl. 22; fig. 1345, pl. 53) (Japan, Aleutian, Hawaiian, and Galápagos Islands to Tasmania and westward to east Africa; in the Atlantic north to the Bay of Biscay and the Caribbean Sea; chiefly in deep water, but a few species are sublittoral)------------------------ **Thalassometrinae** (pt. 4).

g^2. P_1 similar to P_2, but shorter (vol. 1, pt. 2, fig. 280, p. 213; fig. 285, p. 215); cirri exceedingly long; color sometimes blotched (vol. 1, pt. 2, figs. 203–208, p. 137 and following; fig. 1346, pl. 53) (Japan to Tasmania and the Bay of Bengal; sublittoral, in south Australia also littoral)------------ **Ptilometrinae** (pt. 4).

f^2. Cirri usually short, stout, and strongly curved, rarely more or less elongated, composed of usually fewer than 25 segments, of which the outer are little, if at all, shorter than the earlier and bear no dorsal processes, or at most a low blunt tubercle at the distal end; surface of all the segments uniform in color and dull; no transition segment; color plain (vol. 1, pt. 2, figs. 226–232, p. 180 and following; fig. 1347, pl. 54) (Japan to the Kermadecs and westward to east and south Africa; Caribbean Sea; sublittoral to abyssal)--------------------------- **Charitometridae** (pt. 4).

Suborder OLIGOPHREATA A. H. Clark

Thalassometroida A. H. Clark, American Naturalist, vol. 42, No. 503, 1908, p. 722 (a new suborder; triangular pinnules and small eggs).

Comatulida Oligophreata A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 174 (includes Comasteridae, Zygometridae, Himerometridae, Colobometridae, Thalassometridae, and Tropiometridae); Crinoids of the Indian Ocean, 1912, p. 43 (in key); Die Crinoiden der Antarktis, 1915, p. 110 (synonymy; diagnosis; geological, geographical, bathymetrical, and thermal ranges),

Oligophreata A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 649 (includes Comasteridae. Zygometridae, Himerometridae, Stephanometridae, Pontiometridae, Mariametridae, Colobometridae, Thalassometridae, Calometridae, and Tropiometridae).—A. H. Clark, Die Fauna südwest Australiens, vol. 3, Lief. 13, 1911, p. 438 (analysis of Australian species); Memoirs Australian Mus., vol. 4, 1911, p. 717 (proportion of the species of this suborder in Australia as known to P. H. Carpenter); p. 720 (representation in the Australian fauna); Crinoids of the Indian Ocean, 1912, p. 6 (50 genera in the East Indian region; 280 species in the same region; in other regions macrophreate species far outnumber the species of this suborder); in Springer and Clark, Zittel-Eastman's Paleontology, 1913, p. 236 (diagnosis; includes nearly a dozen different families); Bull. de l'Institut océanographique, Monaco, No. 294, 1914, p. 2 and following (range; structural relation to temperature); Journ. Washington Acad. Sci., vol. 4, No. 20, 1914, p. 581 (relation to temperature); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, p. 3 and following (Atlantic and corresponding Indo-Pacific genera); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range and its phylogenetic and palaeontological significance); Die Crinoiden der Antarktis, 1915, p. 163 (all 4 crinoids known from South Africa belong to 4 different families of this order); Amer. Journal of Science, vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 1; Smithsonian Miscell. Coll., vol. 72, No. 7, 1921, pp. 3, 12, 20, 21.

Oligophreaten A. H. Clark, Die Crinoiden der Antarktis, 1915, p. 167 (of the 7 South Australian crinoids, 5 belong to this suborder).

Diagnosis.—A suborder of Comatulida in which the cavity in the centrodorsal containing the chambered organ and overlying structures is very small and shallow; the rosette is sunk below the dorsal surface of the radial pentagon, and both the radial and interradial extensions form "spoutlike" processes; the central portion of the radial pentagon is more or less completely filled with an irregular calcareous deposit which forms a central plug; the plane of the muscular fossae on the radial articular faces makes a considerable angle with the dorsoventral axis, or the muscular fossae are very greatly reduced; the joint face elements distal to the transverse ridge are not at all, or are only slightly, excavated interiorly; the brachials from about the fourteenth onward are usually short, generally much broader than long; the second brachial syzygy is almost invariably beyond the ninth brachial; the brachial syzygies are usually more or less widely and irregularly spaced; the pinnules, always the proximal and in some groups all, are wholly or in part prismatic with a dorsal carination which may be confined to the earlier segments; segments of the distal pinnules beyond the third not especially slender or elongated, and the first 2 not appreciably broadened; never more than 5 radials; arms 10 or more in number, very commonly more than 10.

Geographical range.—Western Aleutian, Hawaiian and Galápagos Islands to New Zealand and Tasmania and westward to east Africa and the Crozet Islands; in the Atlantic from Tristan da Cunha and southern Brazil to Brittany and North Carolina.

This suborder is not represented in the Arctic or Antarctic regions, on the western coast of North or South America, or in the Norwegian, Mediterranean, Bering, Okhotsk, or Japanese Seas, except that it just enters the southeastern portion of the last through the Korean Straits.

Bathymetrical range.—From between tide marks down to 2,926 meters.

Thermal range.—From the high temperatures of the tropical littoral down to 1.22° C.

History.—The first attempt to divide the living comatulids into two large groups was made by the present author in 1908 in the following words:

> The comatulids are divided into two great groups, one with triangular pinnules and small eggs, the Thalassometroida, the other with round pinnules and large eggs, the Antedonoida.

The groups were not further defined at that time, nor were the included families or genera mentioned.

In 1909 these same two groups were distinguished as the Comatulida Oligophreata and the Comatulida Macrophreata, and diagnoses were given. The families included in the Comatulida Oligophreata were the Comasteridae, Zygometridae, Himerometridae, Colobometridae, Thalassometridae, and Tropiometridae. At that time the family Zygometridae included the Eudiocrinidae, the Himerometridae included the Mariametridae, the Thalassometridae included the Charitometridae, and the Tropiometridae included the Calometridae.

In the same paper the family Comasteridae was divided into the subfamilies Capillasterinae, Comactiniinae, and Comasterinae, the family Himerometridae was divided into the subfamilies Himerometrinae, Stephanometrinae, and Mariametrinae, and the family Pontiometridae was proposed for the curious genus *Pontiometra.*

In 1911 the name of the suborder was given as Oligophreata, and the following families were included in it: Comasteridae, Zygometridae, Himerometridae, Stephanometridae, Pontiometridae, Mariametridae, Colobometridae, Thalassometridae, Calometridae, and Tropiometridae. Since that time there has been no change in the status of the suborder.

Superfamily COMASTERIDA Gislén

Comasterida Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 229 (including the family Comasteridae only).

While the family Comasteridae includes a considerable number of generic types, the three groups into which these fall are not so sharply differentiated from each other as are the corresponding groups of genera in the Mariametrida and the Tropiometrida.

On the basis of the interrelationships of the included genera the family Comasteridae is essentially the equivalent of the larger families in the Mariametrida and Tropiometrida, but as a group the comasterids form a sharply defined unit which is quite the equivalent of the Mariametrida and Tropiometrida.

The systematic interrelationships within the Oligophreata may therefore most correctly be expressed by placing the comatulids with combed oral pinnules in a single family, the Comasteridae (including three subfamilies, the Capillasterinae, Comactiniinae, and Comasterinae) and creating the superfamily Comasterida with the Comasteridae as the only included family.

Family COMASTERIDAE A. H. Clark

Actinometra J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 180; Archiv für Naturgesch., 1841, vol. 1, p. 140.—Lütken, Cat. Mus. Godeffroy, vol. 3, 1866; vol. 4, 1869, p. 125; vol. 5, 1874, p. 190; vol. 5, 1877, p. 100; vol. 6, 1877.—Lütken, in P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, pt. 1, Dec. 1879, pp. 18–19.—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, pt. 1, Dec. 1879, pp. 1–122; *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884; vol. 26, pt. 60, 1888 [for page references in these 2 volumes see indices].

Actinometridae A. H. Clark, Smithsonian Miscell. Coll. (Quarterly Issue), vol. 50, pt. 3, 1907, p. 344 (includes *Comatula;* part of Comatulidae as understood by P. H. Carpenter); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 494 (history; renamed Comasteridae).

Comasteridae A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (includes *Comatula* and *Comaster);* Proc. U. S. Nat. Mus., vol. 34, 1908, p. 210 (in key); p. 211 (includes *Comaster* and *Comatula;* range); p. 211 (not represented in the Hawaiian Is.); p. 212 (range of included genera); vol. 35, 1908, figs. 20, 21, p. 120; figs. 22, 23, p. 121; fig. 24, p. 122 (arm structure); p. 125 (relation to *Uintacrinus*); Amer. Naturalist, vol. 42, No. 503, 1908, p. 722 (ecology); p. 725 (color); Geographical Journal, vol. 32, No. 6, 1908, p. 602 (genera characteristic of Indo-Pacific-Japanese region); p. 606 (ecology); Amer. Naturalist, vol. 43, 1909, p. 256 (not known from the Red Sea); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 361 (equivalent to *Actinometra* of P. H. Carpenter); p. 362 (characters; ambulacral plating in this family first shown by Springer in *Comaster* [*Neomaster*] *iowensis*); p. 494 (reason for use of this name; revision of the family); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 174 (referred to Comatulida Oligophreata); p. 175 (divided into Capillasterinae, Comactiniinae, and Comasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 119 (occurs at Singapore; has large eggs which presumably develop rapidly; ecology); p. 123 (combed oral pinnules possibly used for removing foreign bodies and parasites such as pentacrinoid young and myzostomes from the disk and pinnules); pp. 148–149 (variation of the arm tips and its significance); Amer. Journal of Science, vol. 29, 1910, p. 353 (more or less bilaterally symmetrical); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (6 species in Africa); p. 7 (species on N. W. coast); p. 8 (species on S. E. and N. E. coasts); p. 10 (West Indian and corresponding East Indian genera); p. 649 (referred to Oligophreata); p. 653 (reason of many coiled digestive tube is great amount of inorganic matter ingested with food; reason for the same in *Uintacrinus* probably great amount of pelagic plants in food); Amer. Journal of Science, ser. 4, vol. 32 (old ser. vol. 182), No. 188, Aug. 1911, p. 131 (significance of variations in the centrodorsal); Die Fauna südwest Australiens, vol. 3, Lief. 13, 1911, p. 438 (8 genera and 18 species in Australia); p. 449 (shortness of posterior arms in many species due to the effect of heat); Mem. Australian Mus., vol. 4, 1911, p. 717 (proportion of the species in the Australian fauna as known to P. H. Carpenter); p. 720 (proportion of the species of this family in the Australian fauna); p. 724 (4 species, all extreme types, peculiar to Australia); p. 725 (*Cominia* [*Comatulides*] and *Comissia* absent from Australia; this family disproportionately developed in Australia); p. 729 (in key); p. 730 (key to Australian genera); Crinoids of the Indian Ocean, 1912, p. 6 (number of genera in the East Indian region; number of genera also found in the Atlantic; number of genera represented by closely allied genera in the Atlantic; genera exclusively confined to the East Indies; number of East Indian species); p. 11 (represented by *Comatella*, *Capillaster*, *Comissia*, *Comaster*, *Comanthina*, and the *Vania* group of *Comanthus* in the Ceylon region); p. 12 (represented in the Red Sea by the *Vania* group of *Comanthus* [error]; represented in S. E. Africa by *Comatella*, *Capillaster*, *Comissia*, *Bennettia*, and *Vania*); p. 13 (East Indian and corresponding West Indian genera); p. 20 (distribution in detail); pp. 44, 48, 50, 52 (in keys); p. 54 (key to the subfamilies and to the genera); Amer. Naturalist, vol. 47, No. 560, 1913, p. 498 (secondary radial symmetry of the disk).—F. Springer and A. H. Clark, Zittel-Eastman's Paleontology, 1913, p. 236 (in Oligophreata).—A. H. Clark, Bull. de l'Institut océanographique, Monaco, No. 294, pp. 7, 8 (relation to temperature); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, p. 3 and following (Atlantic and corresponding Indo-Pacific genera); Records Western Australian Museum, vol. 1, pt. 3, 1914, p. 114 (genera and species collected by the *Endeavour* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range; phylogenetical and paleontological significance); Die Crinoiden der Antarktis, 1915, p. 163 (represented in South Africa by *Comanthus wahlbergii*); Amer. Journal of Science, vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of distribution of Australian species); Smithsonian Miscell. Coll., vol. 65, No. 10, 1915, p. 37 and following (phylogenetical study); Amer. Naturalist, vol. 49, p. 526 (asymmetry almost universal in this family, which includes the most specialized of all recent crinoids); p. 527 (types of asymmetry); p. 546 (asymmetrical through excessive warmth); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 1 (key to the included subfamilies); Journ. Washington Acad. Sci., vol. 9, No. 5, p. 136 (asymmetry compared with that of *Holopus*); University of Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 22; Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pp. 3, 6, 7, 8, 9, 10, 13, 32, 39.

Comastéridés A. H. Clark, Bull. du mus. d'hist. nat., Paris, No. 4, 1911, p. 246.

Diagnosis.—A family of the suborder Oligophreata in which the oral pinnules are slender, becoming flagellate and very flexible in the outer half, and are composed of numerous short segments few or none of which are longer than broad; the terminal portion of one or more of the oral pinnules bears a conspicuous comb-like structure, from 3 to 35 (usually between 10 and 20) of the terminal segments carrying on their outer ventral edge a high, thin, lanceolate or more or less rounded blade which is sometimes repeated, reduced in size, on the inner ventral edge. (Vol. 1, pt. 2, pp. 311, 319, pl. 17.)

The anal tube usually occupies a position at or near the center of the disk, the mouth being marginal and situated in a peripheral groove, interrupted posteriorly, into which run the ambulacral grooves from the arms (vol. 1, pt. 2, pl. 24); but rarely the mouth is central with 5 groove trunks radiating from it, and the anal tube is marginal or submarginal (vol. 1, pt. 2, figs. 686, 687, 697, 698, p. 341).

Sacculi are absent, excepting in *Comatonia* and *Comatilia*.

In very many species more or fewer of the arms are ungrooved (vol. 1, pt. 2, pp. 91, bottom, to 95), and these may be much shorter than the other arms. (Vol. 1, pt. 2, fig. 163, p. 86.)

The arms are 10 or more in number, but usually more than 10.

In many Indo-Pacific species, and in a greater or lesser proportion of the individuals in others, the centrodorsal is reduced to a pentagonal or stellate plate and is quite without cirri. (Vol. 1, pt. 1, figs. 165–170, p. 229.)

Geographical range.—From Japan and Polynesia to New Zealand and Tasmania, and westward to the entire eastern coast of Africa; from Brittany to the Canary Islands, and from North Carolina to Rio de Janeiro, Brazil.

Bathymetrical range.—From the shore line down to 1,710 meters; but the great majority of the species are littoral and sublittoral.

History.—The first student of the Crinoidea definitely to set off from the remainder of the comatulids any member of this group was Louis Agassiz who in 1836 established the genus *Comaster* which was based upon the *Comatula multiradiata* of Lamarck. The only character he gave for his new genus, however, was the possession of more than 10 arms.

In 1840 Johannes Müller examined in the Vienna Museum a very large dried specimen of *Comatula solaris*. This he made the type of a new genus which he called *Actinometra* in 1841, describing it under the name of *Actinometra imperialis*. He remarked that the animal in question, *Comatula solaris* Mus. Vienn., one of the colossal forms of living crinoids, has no trace of grooves running to the center of the disk. The middle of the ventral surface of the disk is occupied by a tube. The arms are provided with grooves, the grooves from the 10 arms debouching at regular intervals into a circular groove running about the periphery of the disk. He was unable to find the mouth. The other characters, he said, were the same as in the other comatulids. In 1841 he also discussed Agassiz' genus *Comaster*, but he assumed that it was based upon the *Comatula multriadiata* described and figured by Goldfuss in 1832 instead of on the *Comatula multiradiata* of Lamarck.

In 1843 Müller wrote that he had found the same disk structure in two other comatulids in the museum at Lund. These were the two described by Retzius in 1805 as *Asterias multiradiata* and *Asterias pectinata*, and were the types of the Linnean species of the same names.

In his monograph published in 1849 Müller used the generic name *Comatula* for all the comatulids. The species in which five radiating grooves reach the disk he assigned to the subgenus *Alecto*, which he placed in parentheses after *Comatula*, while those species in which fewer than five grooves reach the disk he assigned to the subgenus *Actinometra*. He had found that the groove about the periphery of the disk in *Actinometra* is not continuous as he had at first thought.

Three species were assigned to the subgenus *Actinometra;* these were *solaris* Lamarck (including *imperialis* J. Müller, *pectinata* Linné, and *purpurea* J. Müller), *rotalaria* Lamarck, and *wahlbergii* J. Müller.

Among the 15 species assigned to the subgenus *Alecto* four belong to the Comasteridae; these are *echinoptera* J. Müller, *fimbriata* Lamarck, *parvicirra* J. Müller, and *multiradiata* Linné.

Species which he was unable to place either in *Alecto* or *Actinometra* because they had been dried and the disk lost or distorted, or because the arms were intertwined ventrally concealing the disk, or for some other reason, he referred simply to *Comatula*. There were 17 of these, of which 9 belong to the Comasteridae. These 9 were *brachiolata* Lamarck, *rosea* J. Müller, *cumingii* J. Müller, *trichoptera* J. Müller, *japonica* J. Müller, *multifida* J. Müller, *timorensis* J. Müller, *novae-Guineae* J. Müller, and *bennetti* J. Müller.

Dujardin and Hupé in 1862 gave the history of the genus *Actinometra* and said that it scarcely differs from *Comatula* other than in having the anus at the center and the mouth at the margin of the disk. Under the generic name *Actinometra* they described four species, *imperialis* J. Müller (also described on another page as *Comatula solaris*), *pectinata* Linné, *multiradiata* Linné, and *wahlbergii* J. Müller. They also recognized the genus *Comaster* as distinct both from *Comatula* and from *Actinometra* and described as *Comaster multiradiatus* the specimen originally described and figured by Goldfuss.

Prof. C. F. Lütken in 1866 and subsequently adopted the generic name *Actinometra* for all the species known to him which now are assigned to the family Comasteridae. He never published anything in regard to his reasons for doing this. But the fact that he made this distinction, and furthermore made it along the lines subsequently elaborated by P. H. Carpenter, is evident from the lists of names of comatulids published in the catalogues of the Museum Godeffroy at Hamburg. In the catalogue published in 1866, we find *Actinometra trachygaster*, which is repeated in 1869; in 1874 he listed *Actinometra gracilis*, *Actinometra intricata*, *Actinometra stellata*, and *Actinometra tenax*, and in 1877 *Actinometra brachymera* and *Actinometra fusca*. All of these names are *nomina nuda*, but all of them have been identified. In addition to these, the names *Actinometra guttata*, *Actinometra affinis*, and *Actinometra macrobrachius* are found with specimens identified by him. The species belonging to all the other groups were assigned by Doctor Lütken to the genus *Antedon*.

In an elaborate memoir on the genus *Actinometra* published in 1879 Dr. P. H. Carpenter first definitely pointed out the features characteristic of the comasterids.

In this memoir Carpenter quoted the following from an unpublished manuscript of Professor Lütken:

> The lower or oral pinnules of *Actinometra* are always very different from the others, being flagelliform and presenting a more or less distinct serrature or comb (pinnulae orales prehensiles); while in *Antedon* they are only slightly differentiated from the others, or are transformed into strong rigid spines, forming a protective covering over the disk.

Lütken also said that the number of ambulacral furrows abutting on the mouth, the character used by Müller in differentiating *Actinometra*, is of no importance at all. But the anal tube in all the species of *Actinometra* has a central or subcentral position and the anal area occupies the larger portion of the disk. Using this feature as a primary differential character, Doctor Lütken said that he had never encountered a doubt whether any type should be referred to *Antedon* or to *Actinometra*, although he had examined a great number of specimens and of species.

Carpenter confirmed Lütken's observations and discussed at great length the characters presented by the species of *Actinometra*. He referred to this genus *solaris* Lamarck, *pectinata* Linné, *brachiolata* Lamarck, *robusta* Lütken (manuscript name), *rotalaria* Lamarck, *polymorpha*, sp. nov., *trichoptera* J. Müller, *wahlbergii* J. Müller, *fimbriata* Lamarck, *multifida* J. Müller, *multiradiata* Linné, *parvicirra* J. Müller, and *bennettii* J. Müller, and also, with a query, *purpurea* J. Müller, *rosea* J. Müller, *echinoptera* J. Müller, and *meridionalis* E. C. and A. Agassiz. The last four he knew only from descriptions. Seven species described by Müller he was unable to examine and from the descriptions he could not obtain any information regarding the position of the mouth or the character of the oral pinnules. Four of these seven, *cumingii* J. Müller, *japonica* J. Müller, *novae-Guineae* J. Müller, and *timorensis* J. Müller, belong to the Comasteridae.

In 1884 Carpenter distributed the species of *Actinometra* among eight specific groups which were based upon the type of arm division. These specific groups were as follows:

A. Ten arms only; a synarthry between the first two brachials	Group of *Actinometra meridionalis.*
B. IIBr 2 (1+2)	Group of *Actinometra jukesi.*
C. IIBr 2	Group of *Actinometra pulchella.*
D. IIBr 4 (3+4)	Group of *Actinometra parvicirra.*
E. IIIBr 2 (1+2)	Group of *Actinometra typica.*
F. IIIBr 2	Group of *Actinometra stelligera.*
G. IIIBr 3 (2+3)	Group of *Actinometra multiradiata.*
H. IIIBr 4 (3+4)	Group of *Actinometra bennetti.*

He mentioned these divisions of the genus merely to illustrate the fact that in the single species *Neocrinus decorus* various types of IIBr and IIIBr series occur which are specially characteristic of different groups of species in *Actinometra*.

In 1888 Carpenter divided the genus *Actinometra* into eight specific groups included in four series, as follows:

Series I: IBr series 2 (1+2); first arm syzygy between brachials 1+2:	
1. Ten arms	*Solaris* group.
2. IIBr series 2 (1+2)	*Paucicirra* group.
3. IIBr series 4 (3+4)	*Typica* group.
Series II: IBr series 2; 10 arms:	
4. IBr 2; 10 arms	*Echinoptera* group.

Series III: IIBr series 2; more than 10 arms:

5. All division series 2; first brachial syzygy between brachials 1 + 2 ---------------------------- *Stelligera* group.
6. IIBr 2; first brachial syzygy between brachials 3 + 4 - *Valida* group.

Series IV: IIBr series 4 (3 + 4):

7. IIBr series 4 (3 + 4); IIIBr series 3 (2 + 3); first arm pinnule on the first brachial, and a syzygy between brachials 2 + 3 ------------------------ *Fimbriata* group.
8. IIBr series 4 (3 + 4); first arm pinnule on the second brachial, and a syzygy between brachials 3 + 4 --- *Parvicirra* group.

In 1907 the present author established the family Actinometridae, including the genus *Comatula* used as the equivalent of *Actinometra* as employed by Carpenter.

Since *Actinometra* is a pure synonym of the earlier *Comatula*, both having as the genotype *Comatula solaris*, the name Actinometridae was changed in the following year to Comasteridae.

The family Comasteridae as understood in 1908 included the genera *Comatula* and *Comaster*. The generic name *Comaster* was taken as the basis for the family name, since Comatuladae or Comatulidae had been used with various meanings since 1828.

Note.—For keys to the subfamilies included in the family Comasteridae see p. 69.

ARTIFICIAL KEY TO THE GENERA OF THE FAMILY COMASTERIDAE

- *a*¹. Ten arms only.
  - *b*¹. Cirri present.
    - *c*¹. All of the pinnules present.
      - *d*¹. Combs with more than 3 teeth; cirri not excessively slender with excessively elongated segments; arms more than 20 mm. in length.
        - *e*¹. Comb confined to the distal portion of the proximal pinnules, never extending basalward so far as the middle; teeth of the combs little, if any, higher than the width of the segments that bear them; no spinous median knobs or keels on the earlier brachials.
          - *f*¹. Several of the distal cirrus segments preceding the penultimate bear each a dorsal tubercle, spine, or transverse ridge.
            - *g*¹. Outer cirrus segments carinate dorsally and with a dorsal tubercle or small spine; distal ends of the basal segments of the lower pinnules not markedly enlarged.
              - *h*¹. No conspicuous carinate processes on the first and second segments of the proximal pinnules (Seychelles, Amirante Islands, the Red Sea, and Ceylon to tropical Australia, the Bonin Islands, southern Japan, the Philippines, and Macclesfield Bank; 0–984 meters) ---------------------- **Comissia**, p. 244.
              - *h*². First and second segments of the proximal pinnules with a very high and prominent carinate process of which the outer edge, at least on the second segment, is parallel with the longitudinal axis of the pinnule (Caribbean Sea and Gulf of Mexico; 0–479 meters) ------------------------ **Leptonemaster**, p. 275.
            - *g*². Outer cirrus segments not carinate dorsally, each bearing dorsally a straight transverse ridge; distal ends of the basal segments of the lower pinnules with greatly flaring spiny distal ends which project as rough spurs on the aboral side (Bass Strait and the coast of Victoria; 119 [?91]–183 [?311] meters) ---- **Comanthoides**, p. 240.
          - *f*². No dorsal processes on the outer cirrus segments except for the opposing spine on the penultimate segment; cirrus segments more or less subequal.
            - *g*¹. Less than 25 cirrus segments, of which at least some, and commonly all but the first 2, are longer than broad.

h^1. Elements of the IBr series and first 2 brachials short and very broad, in close apposition with their neighbors on either side; segments of the genital pinnules short and broad, in the basal half of the pinnules usually much broader than long, and more or less produced aborally; cirri short, rather stout, and usually few in number.

i^1. Elements of the IBr series and first 2 brachials united by syzygy, or by an exceedingly close synarthry which appears externally as a uniformly narrow, or dotted, line; 2 or more of the basal segments of the proximal pinnules usually bear a prominent carinate process (Ceylon and the Gulf of Martaban to tropical Australia, south to between Fremantle and Geraldton on the west and Sandon Bluffs on the east, northward to Luzon, the China Sea and Hong Kong, and eastward possibly to the Society Islands; 0–109 meters) -- **Comatula, p. 302.**

i^2. Elements of the IBr series and first 2 brachials united by synarthry, the line of union appearing externally as 2 very narrow triangles converging to a common apex in the median line; no prominent carinate processes on the basal segments of the proximal pinnules (Cape Lookout, N. C., southward, throughout the Caribbean Sea, to Rio de Janeiro; 0–508 [?510] meters).

Comactinia, p. 374.

h^2. Elements of the IBr series longer and narrow, free laterally and widely separated from their neighbors; segments of the genital pinnules beyond the first 2 as long as, or longer than, broad; cirri long, slender, and numerous (southwestern Japan to the Lesser Sunda Islands; 311–984 meters) - **Comatulides, p. 400.**

g^2. More than 30 cirrus segments which, except for the penultimate, are twice as broad as long or even broader (southwestern and southern Australia from Perth, Western Australia, to Port Phillip, Victoria; 0–18 meters).

Comatulella, p. 295.

e^2. Terminal comb on the proximal pinnules very long, usually arising at about, or even within, the end of the proximal third of the pinnules; teeth of the combs usually much exceeding in height the width of the segments that bear them; fourth–seventh brachials with prominent spinous median dorsal knobs or keels (Key West, Fla., to Cape Lookout, N. C.; 14–241 meters) ------------------------ **Comatonia, p. 288.**

d^2. Combs on the proximal pinnules with 3 teeth only; cirri excessively slender and threadlike, the enormously elongated segments with greatly swollen articulations; the penultimate segment, which is much shorter than those preceding, is twice as long as broad; arms not more than 15 mm. in length (Virgin Islands; 91–183 meters).

Microcomatula, p. 287.

c^2. Second, third, and fourth pairs of pinnules absent, so that there are no pinnules between P_1 and P_5 and P_a and P_e (off Georgia; 512 meters) ------------------- **Comatilia, p. 284.**

b^1. Cirri absent, the centrodorsal being reduced to a stellate, pentagonal, or more or less irregular plate (Gulf of Martaban and the Andaman Islands to Australia, south on the east coast to Sandon Bluffs, New South Wales; 0–109 meters) ------------------ **Comatula, p. 302.**

a^2. More than 10 arms.

b^1. Cirri present.

c^1. First pinnule of the undivided arms arising from a IIBr or subsequent axillary on the first brachial, and a syzygy between brachials 2+3; IIBr series 4 (3+4), or 4 (3+4) and 2; IIIBr and following division series, if present, and very exceptionally the IIBr series, 3 (2+3); division series sometimes very irregular.

d^1. Distal cirrus segments more or less strongly carinate dorsally, with a dorsal tubercle or small spine in the middorsal line, or a V-shaped row of tubercles, of which the largest is at the apex of the V.

e^1. Brachials much broader than long, wedge-shaped or oblong (Madagascar, Mauritius, the Maldive Islands, and Ceylon to northern Australia, the Caroline Islands, southwestern Japan, the Philippines, and Formosa [Taiwan]; 0–292 meters).

Capillaster, p. 156.

e^{2}. Brachials beyond the basal triangular, about as long as broad, becoming elongate wedge-shaped distally (Bahamas and Dry Tortugas, throughout the Caribbean Sea, and southward to Bahia, Brazil; 0–355 meters).............. **Nemaster**, p. 214.

d^{2}. Distal cirrus segments not carinate dorsally, each bearing a straight transverse ridge; distal ends of the basal segments of the lower pinnules with greatly flaring spiny distal ends, projecting as rough spurs on the aboral side (Bass Strait and the coast of Victoria; 119[?91]–183 [?311] meters).............. **Comanthoides**, p. 240.

c^{2}. First pinnule of the undivided arms on the second brachial; a syzygy between brachials 3+4 or 1+2, or in both places, but never between brachials 2+3.

d^{1}. All the division series of 2 elements like the IBr series.

e^{1}. Cirri well developed, numerous, and rather long, with the distal segments much shorter than the earlier, broader than long, and each bearing a dorsal spine or tubercle; elements of the division series united by synarthry, though the union may be so close as to appear externally like a syzygy.

f^{1}. Brachials beyond the basal wedge-shaped or almost oblong, broader than long (Salomon, Coin Peros, the Maldive Islands, and Ceylon to the Abrolhos Islands, Western Australia, Torres Straits, New Caledonia, Tonga, Fiji, Samoa, the Bonin Islands, southwestern Japan, the Philippines, and Macclesfield Bank; 0–210 meters).............. **Comatella**, p. 89.

f^{2}. Brachials beyond the basal triangular, about as long as broad.

g^{1}. Centrodorsal moderate in size or small, with the cirri arranged in irregular rows (St. Paul's rocks northward, throughout the Caribbean Sea, to the Dry Tortugas and Bahamas; Canary Islands to Brittany; 13–1,710 meters). **Neocomatella**, p. 122.

g^{2}. Centrodorsal large and broad, thick discoidal, with the cirri arranged roughly in 25 columns (Kei and Philippine Islands; 256–275 meters). **Palaeocomatella**, p. 153.

e^{2}. Cirri poorly developed, arranged in a single more or less deficient row, very few in number, short, composed of subequal segments, all of which, except for the first or first 2, are longer than broad; outer cirrus segments without dorsal spines or tubercles, but an opposing spine is usually present; elements of the division series united by syzygy (Aru Islands and northern Australia south to Baudin Island, Western Australia, and Port Molle, Queensland; Java and Singapore; 0–69.4 meters). **Comatula**, p. 302.

d^{2}. Some, or all, of the division series of 4 elements.

e^{1}. IIBr series all, mostly, or in part, of 4 elements.

f^{1}. Elements of the IBr series and the first 2 ossicles following every axillary united by syzygy; IIBr series 4 (1+2, 3+4), or partly 4 (1+2, 3+4) and partly 2 (1+2); IIIBr and following series 2 (1+2) or 2, very exceptionally 4 (3+4) (Maldive Islands to Australia, south to Port Walcott, Western Australia, and Port Molle, Queensland, Fiji, the Gilbert [Kingsmill] Islands, southern Japan, the Philippines, Macclesfield Bank, and the coast of China; 0–216 [?538] meters). **Comaster**, p. 409.

f^{2}. Elements of the IBr series and the first 2 ossicles following every axillary united by synarthry; IIBr series 4 (3+4), or partly 4 (3+4) and partly 2.

g^{1}. Distal cirrus segments with or without dorsal tubercles or spines, but never with a straight transverse ridge.

h^{1}. Some or all of the IIIBr series 4 (3+4).

i^{1}. All of the IIIBr series 4 (3+4) (Cape of Good Hope, Madagascar, Mauritius, the Seychelles, and Baluchistan to Australia, including the whole southern coast, Tasmania, New Zealand, New Caledonia, Fiji, Tonga, Samoa, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, the Philippines, Hong Kong, and Amoy, China; 0–256 [?548] meters). **Comanthus**, p. 527.

i^{2}. IIIBr series partly 4 (3+4) and partly 2.

j^1. Outer IIIBr series on each ray 2, the inner 4 (3+4); following division series wholly, or mostly, 4 (3+4); the typical arrangement of the IIIBr series is subject to some variation, especially on the posterior arms, following IIBr 2 series; seldom less than 60 arms (Maldive Islands and Ceylon to Australia, south to the Abrolhos Islands, Western Australia, and the Queensland coast, the Solomon, Caroline, and Philippine Islands, and Macclesfield Bank; 0–548 meters) ---------------- **Comanthina, p. 457.**

j^2. No regularity in the distribution of IIIBr series of 4 (3+4) and 2; very seldom so many as 60 arms (Madagascar, Mauritius, the Seychelles, and Baluchistan to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, and Amoy, China; 0–110 meters) -------------------------- **Comanthus, p. 527.**

h^2. All of the IIIBr series 2; or, exceptionally, IIIBr 4 (3+4) series will follow IIBr 2 series, especially on the posterior arms (Java to Australia, south to the Abrolhos Islands, Western Australia, and Ballina, New South Wales, the Bonin Islands, southern Japan, the Philippines, Formosa [Taiwan], and Fukien Province, China; 0–150 meters) ------------- **Comantheria, p. 483.**

g^2. Distal cirrus segments each with a straight transverse ridge dorsally; usually 10 and never so many as 20 arms (Bass Strait and the coast of Victoria; 119[?91]–183 [?311] meters) -------------------------------- **Comanthoides, p. 240.**

e^2. IIBr series all 2; but some, at least, of the following division series are 4 (3+4) (Madagascar, Mauritius, the Seychelles, and Baluchistan to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, and Amoy, China; 0–110 meters) -------------------------- **Comanthus, p. 527.**

b^2. Cirri absent.

c^1. First pinnule on the undivided arms on the second brachial; a syzygy between brachials 3+4 or 1+2, or in both locations, but never between brachials 2+3; IIIBr series never 3 (2+3).

d^1. Some, or all, of the division series of 4 elements; segments of the genital pinnules not especially short and broad.

e^1. IIBr series all, mostly, or in part, of 4 elements.

f^1. Elements of the IBr series and the first 2 ossicles following every axillary united by syzygy; IIBr series 4 (1+2, 3+4), or 4 (1+2, 3+4) and 2 (1+2); IIIBr and following division series 2 (1+2), only very exceptionally 4 (3+4) (Maldive Islands to Australia, south to Port Walcott, Western Australia, and Port Molle, Queensland, Fiji, the Gilbert [Kingsmill] Islands, southern Japan, the Philippines, Macclesfield Bank, and the coast of China; 0–216 [?538] meters ----------- **Comaster, p. 409.**

f^2. Elements of the IBr series and the first 2 ossicles following every axillary united by synarthry; IIBr series 4 (3+4), or 4 (3+4) and 2.

g^1. Some or all of the IIIBr series 4 (3+4).

h^1. All of the IIIBr series 4 (3+4) (Ceylon to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, and the Philippines; 0–110 meters) -------------------------------- **Comanthus, p. 527.**

h^2. IIIBr series both 4 (3+4) and 2.

i^1. Outer IIIBr series on each ray 2, the inner 4 (3+4); following division series wholly, or mostly, 4 (3+4); IIBr series wholly, or mostly, 4 (3+4); the typical arrangement of the IIIBr series is subject to some variation, on the posterior arms especially, following IIBr 2 series; seldom less than 60 arms (Maldive Islands and Ceylon to Australia, south to the Abrolhos Islands, Western Australia, and Bass Strait, the Solomon, Caroline, and Philippine Islands, and Macclesfield Bank; 0–548 meters) ------- **Comanthina, p. 457.**

i^2. No regularity in the distribution of the IIIBr series of 4 (3+4) and 2; seldom more than 60 arms (Ceylon to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, and the Philippines; 0–110 meters) ------------------------------------ **Comanthus, p. 527.**

g^2. All the IIIBr series 2; or exceptionally IIIBr 4 (3+4) series will follow IIBr 2 series, especially on the posterior rays (Java to Australia, south to the Abrolhos Islands, Western Australia, and Ballina, New South Wales, the Bonin Islands, southern Japan, the Philippines, Formosa [Taiwan], and Fukien Province, China; 0–150 meters) -------------------------------- **Comantheria**, p. 483.

e^2. IIBr series all 2; but some, or all, of the following division series 4 (3+4) (Ceylon to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, and the Philippines; 0–110 meters) ------------ **Comanthus**, p. 527.

d^2. All of the division series of 2 elements united by syzygy, resembling the IBr series; segments of the genital pinnules short and broad, in the basal half of the pinnules usually much broader than long (Aru Islands and northern Australia south to Baudin Island, Western Australia, and Port Molle, Queensland; 0–69.4 meters) --- **Comatula**, p. 302.

c^2. First pinnule of the undivided arms on the first brachial; brachials 2+3 united by syzygy (China Sea to the Borneo Bank; 0–59 meters) -------------------- **Capillaster**, p. 156.

Subfamily CAPILLASTERINAE A. H. Clark

Capillasterinae A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (includes *Nemaster*, *Capillaster*, *Neocomatella*, *Comatella*, *Comatilia*, *Leptonemaster*, and *Comissia*); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (the genus *Comissia* falls in this subfamily); Die Fauna südwest-Australiens, vol. 3, Lief. 13, 1911, p. 438 (2 genera and 3 species in Australia); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 390 (*Neocomatella*, *Comatella*, *Nemaster*, and *Capillaster* all fall in this subfamily); Crinoids of the Indian Ocean, 1912, p. 6 (number of East Indian genera; number of genera also found in the Atlantic; number of genera represented by closely allied genera in the Atlantic; genera exclusively confined to the East Indian region; number of East Indian species); p. 14 (distribution in the East Indies); p. 20 (distribution in detail); p. 54 (in key); Bull. de l'Institut océanographique, Monaco, No. 294, 1914, pp. 7, 8 (relations to temperature); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical ranges); No. 20, p. 582 (relation to temperature of habitat); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 3 and following (Atlantic and corresponding Indo-Pacific genera); Records of the Western Australian Museum, vol. 1, part 3, 1914, p. 114 (genus and species collected by the *Endeavor* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range; phylogenetic and palaeontological significance); Die Crinoiden der Antarktis, 1915, p. 132 (covering plates); Amer. Journal of Science, vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); Smithsonian Miscell. Coll., vol. 65, No. 10, 1915, pp. 42 and following (phylogenetic study); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical and thermal ranges; asymmetrical genera, with bathymetrical ranges); p. 539 (genera with asymmetrical disks; genera with one or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 1 (in key); p. 2 (in key; key to included genera); University of Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (represented in West Indies); p. 22; Smithsonian Miscell. Coll., vol. 72, No. 7, 1921, p. 3.

Capillastérinés A. H. CLARK, Bull. du mus. d'hist. nat., Paris, No. 4, 1911, p. 246.

Diagnosis.—A subfamily of Comasteridae in which the cirri always bear dorsal spines or tubercles on the outer segments and are stout or numerous and well developed; they are absent only in a single species; the arms are 10, or more than 10, in number; when there are more than 10 arms the division series are all 2, or the IIBr series are 4 (3+4), rarely 2, and the following division series are 3 (2+3); when there are more than 10 arms and the division series are all 2 the first syzygy is between brachials 1+2; except occasionally on the outermost arms of each ray, where it may be between brachials 3+4; when the IIBr series are 4 (3+4) the first brachial syzygy is always between brachials 2+3; when the IIBr series are 4 (3+4) the first pinnule of the free arms is on the first brachial following the axillary, and in division series of 3 (2+3) the first element, following the preceding axillary, bears a pinnule; in species with 10 arms, and in species with more than 10 arms in which all the division series are 2, the first pinnule is on the second brachial; the genital pinnules are not especially stout, and their component segments are not especially short.

Geographical range.—From southwestern Japan, the Bonin and Caroline Islands, Samoa, Fiji, Tonga, New Caledonia, and Tasmania westward to the Red Sea, the Amirante Islands, the Seychelles, Madagascar, and Mauritius; from Brittany to the Canary Islands; from Cape Lookout, N. C., and southern and western Florida and the Bahamas southward throughout the Caribbean Sea and Gulf of Mexico to Bahia, Brazil.

Bathymetrical range.—From the low-tide mark down to 1,710 meters. The relative frequency of the included genera at different depths is as follows:

0–100 meters	8	400–600 meters	3
100–200 meters	9	600–1,000 meters	2
200–300 meters	7	Over 1,000 meters	1
300–400 meters	4		

Remarks.—In contrast to the subfamilies Comactiniinae and Comasterinae, the subfamily Capillasterinae is a rather heterogeneous group. Of the 11 included genera, 5 contain invariably 10-armed species, one contains a single species of which most of the individuals have 10 arms, and 5 include species with always more than 10 arms, the number running up to about 100 in exceptional specimens of *Capillaster sentosa*. In several of the multibrachiate species the arm number varies between unusually wide extremes; for instance, in *Comatella nigra* there may be anywhere from 29 to 80 or more arms.

The arm division in *Capillaster* and *Nemaster* is of a curious type not found elsewhere in the comatulids, though occurring in the pentacrinites. The arm division of *Comatella*, *Neocomatella*, and *Palaeocomatella* resembles that found in the multibrachiate species included in the subfamily Comactiniinae.

It was because of the close correspondence in the structure of the cirri that I originally placed *Capillaster*, *Nemaster*, *Comatella*, *Neocomatella*, and *Palaeocomatella* in the same subfamily, their cirri being very different from those characteristic of the species of the Comactiniinae. The correctness of this disposition was later confirmed by the discovery of curious individuals of species of *Capillaster* and *Comatella* which had some of their division series of the type characteristic of the other genus.

In the genera *Capillaster* and *Nemaster* certain individuals of the included species have the division series very highly irregular, and not infrequently consisting of a single axillary ossicle only. This is seen particularly in *Capillaster mariae*, *C. multiradiata*, and *Nemaster iowensis*. Such irregularity in the division series does not occur in any other group of comatulids. While irregularities in the division series are very frequent in most of the species of Comasterinae, they here consist simply of the replacement of a division series of 4 (3+4) by one of 2, or the reverse.

In the Capillasterinae the cirri are always numerous and well developed, excepting only in *Capillaster macrobrachius*, in which species they are absent. The number of cirrus segments varies from 8 or 9 in *Microcomatula* to occasionally 40 or more in *Capillaster sentosa*, and is usually between 12 and 25. The length and stoutness of the cirri and the number of cirrus segments are in general proportionate to the size of the species or the individual. While this is more or less true in all the comasterids, it is especially noticeable in the Capillasterinae. The earlier cirrus segments are always somewhat, and usually considerably, longer than the distal, which bear dorsal spines or tubercles.

The inclusion of the genera containing species with only 10 arms in this subfamily rather than in the Comasterinae calls for a word of explanation. The cirri of these species are quite different from those found in the species of Comactiniinae, since they always have dorsal processes on the distal segments. In the multibrachiate species of Capillasterinae the cirri, in contrast to the arms, are fairly uniform in structure and also in relative size; they are absent in only a single species. The 10-armed comasterids possess cirri which, except for the attenuate cirri of the very small forms, resemble those of the multibrachiate Capillasterinae. A close approach to this type of cirrus is found in certain species of *Comanthus*, such as *C. trichoptera* and *C. japonica*, but the cirri of the 10-armed forms do not resemble the cirri of these species so closely as they do the cirri of the smaller of the multibrachiate Capillasterinae. Besides this, in the 10-armed genera the length, stoutness, and number of segments in the cirri are roughly proportionate to the size of the species, as in the multibrachiate Capillasterinae. In the Comasterinae, on the other hand, the cirri are highly diversified. The distal segments usually bear dorsal processes, but these are very variable, and may be absent, as in *Comanthina schlegelii* and *Comanthus bennetti*. While the cirri may be very large and stout, as in *Comanthus bennetti* and *C. pinguis*, they are commonly weak and poorly developed, more or less deficient, or entirely absent. So there seems to be no escape from the conclusion that the 10-armed genera should be included in the subfamily Capillasterinae.

The single species of the curious genus *Comanthoides* usually has 10 arms, but sometimes more than 10. In the latter case the arm division may resemble that of *Capillaster*, or of the genus *Comanthus* in the Comasterinae. The species of *Comanthoides*, therefore, would seem to be a form uniting, in its multibrachiate individuals, the Capillasterinae and the Comasterinae. In its cirri and pinnules, however, it agrees very closely with the species of *Comissia*, and I believe that it should be regarded as an aberrant member of the Capillasterinae rather than as a connecting link between the Capillasterinae and the Comasterinae.

The tropical American genera of Capillasterinae which include 10-armed species—*Leptonemaster*, *Comatonia*, *Comatilia*, and *Micromatula*—are especially interesting. In *Comatilia* we find the only comasterid with deficient pinnulation, there being no pinnules between the first and the fourth pairs. The single species of *Microcomatula* is the smallest comatulid known, being somewhat smaller than the smallest adults of the minute *Compsometra parviflora*. It has an arm length of only 12 mm. The cirri are greatly attenuated, and the comb on the oral pinnules has only three teeth. Sacculi, otherwise absent in the Comasteridae, occur in *Comatilia* and in *Comatonia*.

It is worthy of note that in many of the small species of Capillasterinae the mouth is always central, while in some of the larger ones, as *Capillaster multiradiata*, it is frequently nearly or even quite central. In the species of Comactiniinae and Comasterinae the mouth is always marginal or submarginal.

The Capillasterinae are remarkable for great diversity in size, in arm structure, and in the position of the mouth, and at the same time for a minimum of diversity in the structure of the cirri, which organs are, with only a single exception, present. They have much the greatest range—geographical, bathymetrical, and thermal—of all the comasterid groups, and include nearly all the comasterid species found below the sublittoral zone.

In the diversity and often extraordinary variability of their arm structure, and in the relative constancy of their cirrus structure, the Capillasterinae suggest the pentacrinites more strongly than do any of the other comatulids.

It is possible to regard the Capillasterinae as suggesting, especially in the small 10-armed genera, the generalized type from which the other comasterids were derived.

History.—The subfamily Capillasterinae was established in 1909 to include the genera *Nemaster*, *Capillaster*, *Neocomatella*, *Comatella*, *Comatilia*, *Leptonemaster*, and *Comissia*. The genera *Palaeocomatella*, *Comatonia*, and *Microcomatula* have been since described, and *Comanthoides* is described herein.

Of the groups mentioned by Carpenter in the *Challenger* report (1888) the *Stelligera* and *Fimbriata* groups fall within the Capillasterinae. A species mentioned by him as belonging to the *Paucicirra* group (included in the Comactiniinae), and subsequently (1889) described as *Actinometra notata* (=*Comatella stelligera*), also belongs here. In addition, under "*Actinometra*, Series II," which includes the *Echinoptera* group only, Carpenter refers to certain 10-armed species of Capillasterinae, though without mentioning any names, and he also placed here certain specimens of *Neocomatella pulchella*, other specimens of the same species being referred to the *Stelligera* group.

KEY TO THE GENERA OF THE SUBFAMILY CAPILLASTERINAE

a^1. More than 10 arms.

b^1. Outer cirrus segments more or less sharply carinate dorsally, the dorsal processes median spines or tubercles or a tubercular or spinous V-shaped elevation with a sharp median apex.

c^1. First pinnule of the undivided arms on the second brachial; all the division series 2; the first syzygy is between brachials 1+2 except on the outermost arms of each ray, where it is between brachials 3+4; but often on these outermost arms there is also a syzygy between brachials 1+2; never a syzygy between brachials 2+3.

d^1. Brachials beyond the basal wedge-shaped and broader than long (Salomon, Coin Peros, the Maldive Islands, and Ceylon to the Abrolhos Islands, Western Australia, Torres Straits, New Caledonia, Tonga, Fiji, Samoa, the Bonin Islands, southwestern Japan, the Philippines, and Macclesfield Bank; 0–210 meters)-------------- **Comatella**, p. 89.

d^2. Brachials beyond the basal triangular, about as long as broad.

e^1. Centrodorsal of moderate size, with the cirri arranged in very irregular rows (St. Paul's rocks northward throughout the Caribbean Sea to the Dry Tortugas and the Bahamas; Canary Islands to Brittany; 13–1,710 meters)-- **Neocomatella**, p. 122.

e^2. Centrodorsal large with the cirri arranged more or less in 25 closely crowded and irregular columns, usually of 2 each (Kei and Philippine Islands; 256–275 meters).
Palaeocomatella, p. 153.

c^2. First pinnule of the undivided arms on the first brachial; IIBr series 4 (3+4) and following division series 3 (2+3); division series occasionally very irregular; always a syzygy, in arms arising from a IIBr or later axillary, between brachials 2+3.

d^1. Brachials much broader than long, oblong or wedge-shaped (Madagascar, Mauritius, the Maldive Islands, and Ceylon to tropical Australia, the Caroline Islands, southwestern Japan, the Philippines, and Formosa [Taiwan]; 0–292 meters).
Capillaster, p. 156.

d^2. Brachials triangular, about as long as broad, becoming elongate wedge-shaped distally (Bahamas and Dry Tortugas, throughout the Caribbean Sea, and southward to Bahia, Brazil; 0–355 meters) -- **Nemaster**, p. 214.

b^2. Outer cirrus segments not carinate dorsally, the dorsal processes, including the opposing spine, in the form of a straight transverse ridge; arms 10–19, but usually 10, and very rarely over 13, in number (Bass Strait and coast of Victoria; 119 [?91]–183 [?311] meters). **Comanthoides**, p. 240.

a^2. Arms 10 in number.

b^1. All the pinnules present.

c^1. Cirri never excessively slender; arms more than 20 mm. in length.

d^1. Outer cirrus segments more or less sharply carinate dorsally, the dorsal processes median spines or tubercles or spinous V-shaped elevations with a sharp median apex.

e^1. First and second segments of the proximal pinnules with a very high and prominant carinate process, of which the crest, at least on the second segment, is parallel with the longitudinal axis of the pinnule (Caribbean Sea and Gulf of Mexico; 0–479 meters) -- **Leptonemaster**, p. 275.

e^2. No carinate processes on the basal segments of the proximal pinnules.

f^1. Pinnules of the first 2, 3, or 4 pairs with terminal combs which are confined to the distal half and are composed of teeth which are seldom, and never much, higher that the width of the segments bearing them; none of the segments of the proximal pinnules more than very slightly longer than broad; no modification of the dorsal surface of the lower brachials; brachials and pinnule segments with very spinous distal edges (Seychelles, Amirante Islands, the Red Sea, and Ceylon to northern and eastern Australia, the Bonin Islands, southern Japan, the Philippines, and Macclesfield Bank; 0–984 meters) -------------------------- **Comissia**, p. 244.

f^2. Terminal comb occurring only on the pinnules of the first pair (P_1 and P_a), from one or both of which it may be absent; combs arising at about, or even proximal to, the end of the proximal third of the pinnule, and composed of exceptionally large rounded teeth which usually much exceed in height the width of the segments bearing them; usually one or more of the earlier segments of P_1 twice as long as broad, or even longer; fourth-seventh brachials each with a prominent spinous median knob or keel (Key West, Fla., to Cape Lookout, N. C.; 14–241 meters) -- **Comatonia**, p. 288.

d^2. Outer cirrus segments not carinate dorsally, the dorsal processes, including the opposing spine, in the form of a straight transverse ridge; arms 10–19, but usually 10, and very rarely over 13, in number (Bass Strait and the coast of Victoria; 119[?91]–183 [?311] meters) -- **Comanthoides**, p. 240.

c^2. Cirri excessively slender and threadlike, the enormously elongated segments with greatly swollen articulations; penultimate cirrus segment, which is much shorter than those preceding, twice as long as broad; arms not more than 15 mm. in length (Virgin Islands; 91–183 meters) -- **Microcomatula**, p. 287.

b^2. Second, third, and fourth pairs of pinnules absent, there being no pinnules between P_1 and P_5 and P_a and P_e (off Georgia; 512 meters) ---------------------------- **Comatilia**, p. 284.

Genus COMATELLA A. H. Clark

Actinometra (part) Lütken, Mus. Godeffroy Cat., vol. 5, 1874, p. 190, and following authors.

Comatula (part) Ludwig, Zeitschr. f. wiss. Zool., vol. 26, 1876, p. 361.

Antedon (part) von Graff, *Challenger* Reports, Zoology, vol. 10, part 27, 1884, p. 13.

Calometra (part) A. H. Clark, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, 1907, p. 363.

Phanogenia (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 124.

Comaster (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Comatella A. H. Clark, Smiths. Miscell. Coll., vol. 52, part 2, 1908, p. 207 (diagnosis; genotype *Actinometra nigra* P. H. Carpenter, 1888; arm division); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (mouth nearly or quite central); p. 506 (synonymy; genotype; range); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Capillasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 193 (probably occurs at Singapore, though not yet discovered there); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represented in the West Indies by *Neocomatella*); p. 13 (common to southeast Africa and Ceylon, though not occurring in the Arabian Sea); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (falls in the same family as *Comissia*); Memoirs Australian Mus., vol. 4, part 15, 1911, p. 730 (in key); p. 732 (in key; key to the Australian species); p. 738 (original reference; characters; range; *Neocomatella* a representative); p. 741 (arm division); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (cirri compared with those of *Palaeocomatella*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 390 (represented in the West Indies by *Neocomatella*); Crinoids of the Indian Ocean, 1912, p. 11 (represented in the Ceylon region which is the western limit of the large highly multibrachiate species); p. 12 (represented in the southeast African region); p. 13 (corresponds to the West Indian *Neocomatella*); p. 20 (bathymetric range); p. 55 (in key); p. 68 (original reference; type); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 3 and following (represents *Neocomatella;* range); Beiträge zur Kenntnis d. Meeresf. Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (Indo-Pacific genus occurring at Madagascar and represented in the central Atlantic by *Neocomatella*); Die Crinoiden der Antarktis, 1915, p. 181 (range; represented in the Atlantic by *Neocomatella*); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 3 (in key); p. 4 (key to the included species).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, pp. 35, 38 (brachial homologies).

Diagnosis.—A genus of Capillasterinae in which the arms are more than 10 in number, all of the division series are 2, the first pinnule of the undivided arms is on the second brachial; the first syzygy is between brachials 1+2 except on the outermost arms of each ray where it is between brachials 3+4; and the brachials beyond the basal are short, broader than long, and wedge-shaped.

Geographical range.—Salomon, Coin Peros, the Maldive Islands, and Ceylon to the Abrolhos Islands, Western Australia, Torres Straits, New Caledonia, Tonga, Fiji, Samoa, the Bonin Islands, southwestern Japan, the Philippines, and Macclesfield Bank.

Bathymetrical range.—From the shore line down to 210 meters.

Thermal range.—From the very warm water of the tropical littoral down to at least 13.28° C.; there is, however, only a single definite record.

Remarks.—In their general structure the species of this genus are all very similar, differing chiefly in size and in features commonly correlated with size, such as the number of arms and cirrus segments, and the number of comb-bearing proximal pinnules.

The number of cirrus segments varies from 9–12 in *C. brachycirra* to 25–31 in *C. nigra*, but in all the species the cirri are of the same type. The centrodorsal is always discoidal, more or less thick, with the broad dorsal pole becoming more concave and developing a median rounded pit as the thickness increases. The cirri are arranged in from one to three or more closely crowded and irregular marginal rows.

Because of the close similarity in the form of the centrodorsal and in the structure of the cirri, the large species of this genus have a very considerable superficial resemblance to the species of *Capillaster* of corresponding size with which, until the division series are examined, they are likely to be confused. The general appearance of the small species is, however, very characteristic.

In species of *Comatella* with 20 arms each IBr series bears 2 IIBr series, and each of these IIBr series bears 2 arms. The 2 arms borne by each IIBr axillary are not quite alike, for the outer arm has a syzygy between brachials 3+4, and sometimes also between brachials 1+2, while the inner arm has the first syzygy between brachials 1+2, and none between brachials 3+4, the second syzygy being, as a rule, a considerable distance beyond the first.

In *Comatella stelligera* additional axillaries are typically developed only on the outer side of each ray, so that the IIBr and succeeding axillaries bear an axillary on the face sloping toward the outer side of the ray and an undivided arm on the inner face. This gives the appearance of 2 stout arm trunks arising from the IBr axillary which give off on the inner side undivided arms on alternate segments, finally ending in a pair of arms.

In the very large *C. nigra* each ray typically bears 4 instead of 2 such arm trunks, 2 arising from each IIBr axillary.

The number of arms, at least in the larger species, is variable within rather wide limits. Thus in *C. nigra* the arms may be as few as 27 or 29, or as many as 80 or more, though in most individuals they number between 40 and 55. In *C. stelligera* the arms may be as few as 12 or as many as 45 or even more, though there are usually between 30 and 40 arms.

The number of arms is therefore not wholly reliable as a criterion for the differentiation of the species, in which the most emphasis should be placed on the characters furnished by the size of and number of segments in the cirri.

Terminal combs are found on a variable number of the proximal pinnules, but never beyond the sixth or seventh pair. P_1 is of variable size, but is always much longer than the succeeding pinnules, which decrease in length.

The disk usually bears a greater or lesser number of conspicuous calcareous granules, though it may be naked. The mouth is usually marginal and the anal tube central, or nearly so; but in some individuals both mouth and anal tube are more or less equally subcentral.

In contrast to the variability in the division series of the multibrachiate species in the other comasterid genera the uniformity of the division series in *Comatella* is remarkable. Only two instances of deviation from the usual type have been recorded. In a specimen of *C. nigra* one of the division series was doubled, consisting of 4 ossicles in 2 synarthrial pairs, and in a specimen of *C. decora* Gislén found a IIBr 4 (3+4) series followed by arms having a pinnule on the first brachial and a syzygy between brachials 2+3 as in *Capillaster*.

KEY TO THE SPECIES IN THE GENUS COMATELLA

a^1. Cirrus segments usually 26–30; arms usually more than 40; all the IIIBr series present, and usually numerous IVBr, VBr, and VIBr series, and sometimes VIIBr series, also; the inner branch from each IIBr series in its divisions resembles the outer (from the Philippine Islands to Torres Straits, the Abrolhos Islands, Western Australia, and Sumatra; 0–106 meters). nigra, p. 92.

a^2. Not more than 25 cirrus segments; not more than 35 arms.

b^1. Usually 20–25 cirrus segments; usually 30–40 arms; IIIBr series usually present on outside of rays only, the inner branch from each IIBr series usually remaining undivided (Ceylon to the Abrolhos Islands, Western Australia, Torres Straits, Tonga, Fiji, Samoa, the Bonin Islands, the Philippines, and the Macclesfield Bank; ?coast of China; 0–32 [?73] meters.) **stelligera**, p. 98.

b^2. Cirri with not more than 20 segments; 20 or fewer arms; no division series beyond the IIBr series.

c^1. Cirri with 15–20 segments; usually 20 arms (from the islands in the southwestern Indian Ocean to Ceylon, Torres Straits, Bowen, New Caledonia, Rotuma, the Caroline and Bonin Islands, and southern Japan; 0–15 [?183] meters) ------------ **maculata**, p. 112.

c^2. Not more than 13 cirrus segments.

d^1. Cirrus segments 12–13, of which the longest are not so much as 3 times as long as broad; P_1–P_6 bear combs; P_1 with about 40 segments, and its comb with 12 teeth (southwestern Japan; 174–194 meters) -- **decora**, p. 119.

d^2. Cirrus segments 9–12 (usually 10–11), of which the longest are over 3 times as long as broad; P_1–P_3 bear combs; P_1 with 22–28 segments of which 7–9 bear teeth (Bonin Islands; 164–210 meters) ---------------------------------- **brachycirra**, p. 121.

COMATELLA NIGRA (P. H. Carpenter)

Plate 1, Figure 1; Plate 2, Figure 2; Plate 3, Figure 3

[See also vol. 1, pt. 1, fig. 229 (ventral view of centrodorsal), p. 247; fig. 321 (cirrus), p. 277; fig. 447 (dorsal view of radial pentagon), p. 353; pt. 2, figs. 1, 2 (centrodorsal and radials), p. 6; figs. 156, 157 (analysis of arm division), p. 83; fig. 257 (arm), p. 205; figs. 351–363 and 364–371, pp. 235 and 237 (pinnule tips); figs. 594–596 (comb), p. 309]

[Philippinische] Comatula, sp. LUDWIG, Zeitschr. f. wiss. Zool., vol. 26, 1876, p. 361 (anatomy).

Actinometra nigra (Semper, MS.) W. B. CARPENTER, Proc. Roy. Soc., vol. 24, 1876, p. 451 (nervous system; *nomen nudum*).—P. H. CARPENTER, Journ. Anat. and Physiol., vol. 10, 1876, p. 583 (anatomy); vol. 11, 1876, p. 88, footnote (same); Quart. Journ. Microsc. Sci., vol. 21, 1881, p. 181 (anatomy).—VON GRAFF, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 16, 20, 55 (Bohol, Philippines; myzostomes).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, pp. 96, 111, 120, 121, 122, 124, 416 (anatomy); fig. 6, p. 121; fig. 7, p. 122; pl. 61, fig. 6 (arm section); Ann. and Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 39 (vascular system); *Challenger* Reports, Zoology, vol. 26, part 60, 1888, pp. 58, 304, 309, 367, 381 (discussion; Bohol, Philippines, Prof. C. Semper).—ROLLESTON and JACKSON, Forms of Animal Life, 1888, p. 574.—HAMANN, Jenaische Zeitschr., vol. 23 (neue Folge 16), 1889, p. 296 (anatomy).—KOEHLER, Revue suisse de zool., vol. 3, 1895, p. 293 (synonym of *stelligera*).—PFEFFER, Abhandl. Senck. naturf. Gesellsch., vol. 25, 1900, p. 85 (Ternate).—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 436, 444 (history); Crinoids of the Indian Ocean, 1912, p. 35 (identity).

Comatula nigra VON GRAFF, Das Genus *Myzostoma*, 1877, pp. 17, 23, 72, 79 (Bohol, Philippines; myzostomes; *nomen nudum*).—BRAUN, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; from von Graff).

Actinometra stelligera KOEHLER, Revue suisse de zool., vol. 3, 1895, p. 292 (Bay of Amboina; notes).

Comatella nigra A. H. CLARK, Smiths. Miscell. Coll., vol. 52, part 2, 1908, p. 207 (structure); p. 208 (*Albatross* stations 5136, 5139, 5142, 5145, 5146, 5147; description); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 395 (*Albatross* station 5253); vol. 39, 1911, p. 530 (*Albatross* stations 5356, 5413; description of aberrant specimens); Memoirs Australian Mus., vol. 4, 1911, p. 708 (anatomy has been studied in part); Crinoids of the Indian Ocean, 1912, p. 35 (identity); p. 68 (synonymy; localities); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 3 (no locality; specimen with one division series 4[3+4]).—REICHENSPERGER, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 82 (Aru Is.); p. 83 (Aru Is.; Dobo Strait, 20 m.; characters).—H. L. CLARK, Carnegie Institution of Washington Publication 212, 1915, p. 101 (Mer).—

A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4 (in key ; range); p. 5 (synonymy; detailed account; stations 43, 99, 282; Enkhuizen I.); pp. 271, 272, 275 (listed); pl. 1 (colored figure).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 8 (collected by the Carnegie Exped., 1913); p. 12 (Mer; Port Galera, Mindoro; color in life; remarks); pp. 192 and following (range).—H. L. Clark, Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Abrolhos Is.); p. 232 (Long I.; characters).

Diagnostic features.—The size is very large; the cirri have 25–31 (usually 26–30) segments, and are about 30 mm. long; the arms are 27–80 or more (very rarely less than 40) in number, from 150 mm. to 170 mm. in length; the inner derivative from each IIBr auxillary divides like the outer.

Description.—The centrodorsal is moderately large, discoidal, with the polar area from 5 to 6 mm. in diameter, slightly concave, with a rounded and usually shallow median pit. The cirrus sockets are arranged in 2 or 3 closely crowded alternating marginal rows.

The cirri are XX–XXX, 25–31 (usually 26–30), about 30 mm. in length, long, large, and usually stout. The first segment is very short, and the following gradually increase in length to the sixth, which is about as long as broad; the succeeding segments to the tenth or eleventh are similar, and those following become shorter, about twice as broad as long. The transition segment is the ninth, tenth, or eleventh. In the specimens with comparatively slender cirri the cirrus segments become about as long as broad on the fifth, the sixth to the twelfth being about one-third again as long as broad, and the following again about as long as broad, and short distally. The transition and following segments gradually develop a distal dorsal tubercle which becomes quite prominent, on the outer segments gradually moving to a submedian position and becoming median on the terminal four or five. This tubercle is usually blunt conical, but frequently more or less laterally elongate, especially on the more proximal segments.

The ends of the basal rays are visible as small flattened inconspicuous tubercles in the angles of the calyx.

The radials are very short in the median line, but extend far up in the angles of the calyx. The IBr_1 are very short, oblong, usually with the proximal border slightly convex, well rounded dorsally and laterally, not quite meeting basally, the lateral edges of adjacent IBr_1 diverging. The IBr_2 are very broadly pentagonal, the lateral edges being about as long as those of the IBr_1; they are somewhat over twice as broad as long. The lateral edges of the IBr_1 and IBr_2 make an obtuse angle with each other. The IIBr are 2, almost invariably all present. The IIIBr series are 2, and, like the IIBr series, are almost always all present. IVBr, VBr, VIBr, and rarely VIIBr series are present, always 2, developed externally in reference to the IIIBr series. Some individuals do not have the division carried beyond the IVBr series, though usually VBr series at least are present. The division series are well separated, exposing a strip of perisome between the postradial series, the width of which is equal to about half that of the IIBr series.

Arms 27–80 or more in number (usually 40–45), 150 to 170 mm. long. The first 2 brachials are similar in size and shape, small, slightly wedge-shaped, about three times as broad as long; the first are almost entirely united interiorly, as are the segments immediately following each axillary. The next 5 brachials are oblong, about twice as broad as long, and the following become wedge-shaped or even triangular, about half again as broad as long, then gradually less oblique, about twice as broad as long, which proportion is maintained until the very tip of the arm is reached, the brachials then becoming about as long as broad. After the proximal oblong brachials, which are smooth, the brachials develop very prominent and somewhat overlapping distal ends which are armed with very fine spines, and a striate dorsal surface.

Syzygies occur between brachials 1+2 (on the outermost arms arising from a IIIBr series brachials 3+4), and often again between brachials 3+4 or 4+5; the next syzygy is somewhere between brachials 14+15 and 23+24 (the variation in any one individual being usually not more than 3 or 4 brachials), and the distal intersyzygial interval is 4 muscular articulations.

The pinnules are in general similar to those of *C. stelligera*. P_1 is 25 mm. long, resembling P_1 in *C. stelligera* and with a similar comb. The genital pinnules are about 10 mm. long, and the distal pinnules are 15 mm. long.

The mouth is usually interradial and submarginal. The anal area is very large, naked, or with large scattered calcareous concretions which are sometimes high and conical. The disk is from 30 to 35 mm. in diameter.

The color in alcohol varies from dull yellow to dark yellowish, greenish, or reddish brown; sometimes the specimen, if fresh, is covered with small light green spots, which are especially frequent on the disk.

Notes.—The single specimen recorded from the Aru Islands has 38 arms from 150 to 160 mm. in length; the cirri are XXII, 26, up to about 30 mm. long; the centrodorsal is large, with the dorsal pole flat and slightly depressed in the middle; P_1 on the outer arms reaches a length of 25 mm. or more; P_2 is shorter; both these pinnules have a prominent comb. The distal brachials are not very short, and their distal ends are not produced.

In the specimen collected by MM. Maurice Bedot and C. Pictet at the bay of Amboina and recorded by Professor Koehler, most of the cirri had been broken off, but from the number of the sockets they could not have been more than XVI or XVII. The cirrus segments are especially elongated, and the outermost bear small dorsal spines.

The IBr_1 are largely visible and are united laterally. On some rays there are IVBr series.

There are 44+ arms, most of which are broken.

The first syzygy is between brachials 1+2, and on the external arms following each of the outermost axillaries, but not on the internal, there is another syzygy between brachials 3+4. The second syzygy is at about the sixteenth brachial.

The first pinnule is the longest, the length of the pinnules following decreasing regularly to the fourth or fifth.

The disk is 30 mm. in diameter. The mouth is radial.

Of the specimens collected by the Danish Expedition to the Kei Islands that from station 14 has about 45 arms; the one from station 26 is typical, though rather small; that from station 31 has about 55 arms; the cirri are large and stout, XVI, 27, 30 mm. long; the example from station 40 has 50 arms 150 mm. long; the centrodorsal is rather small, discoidal, with the dorsal pole slightly concave, 5 mm. in diameter; the cirri are XVII, 25–26, about 30 mm. long; the specimen from station 53 is a fine example with 27 arms 165 mm. in length; the IIIBr series are externally developed; the cirri are XX, with some more or less developed in addition, 32–39, up to 37 mm. in length, long and stout; the seventh or eighth is a transition segment; following the transition segment the cirri become somewhat abruptly less stout.

Of the specimens collected by Dr. Th. Mortensen off Jolo, one from about 18 meters has about 50 arms, and the one from about 36–55 meters is large and typical.

Varietal specimens.—The specimen from *Albatross* station 5356 is curious in having only 29 arms, which are 170 mm. in length; the IIBr series bear a IIIBr series externally and an undivided arm internally except in one case, where a IIBr series bears merely 2 undivided arms.

The specimen from *Albatross* station 5413 has 40 arms 170 mm. in length; the cirri are XXI, 30–32, from 30 to 33 mm. in length.

The example from off Long Island, Abrolhos, has 40 arms about 110 mm. long; the "very powerful cirri" are XXII, 25–28; the disk is about 32 mm. in diameter.

In the number of arms and in the arrangement of the arm divisions these specimens resemble typical *stelligera* instead of typical *nigra*, but in the structure of the cirri and pinnules and in all other points they agree with *nigra*. It would thus appear that while the frequency of the arm divisions can usually be relied upon to separate these two forms it is not so reliable as the characters presented by the centrodorsal and the cirri.

Abnormal specimen.—In an example without locality in the British Museum one of the division series is composed of 4 ossicles, of which the outer 2 are united by synarthry.

Anatomical notes.—Dr. P. H. Carpenter found that this species is remarkable for the great development of the branches of the axial cords of the arms and of the parambulacral network which is connected with them in the ventral perisome, and also for the large size of the radial blood spaces beneath the ambulacra.

These large radial blood vessels may frequently be found to contain yellow pigment masses or coagula. They are sometimes triangular in section with the apex pointing downward so as to be received into a strongly marked concavity in the upper edge of the water vessel.

In nearly all the crinoids the epithelial lining of the genital tube is continuous with that of the ovary. Individual cells of this lining enlarge at the expense of their fellows and are gradually inclosed in follicles which are derived from the original ovarian epithelium. These follicles project freely into the lumen of the gland, but there is ordinarily practically nothing that could be called an ovarian stroma. In this species, however, there is a highly organized stroma separating the follicles, and young ova may be found in it at all stages of growth, the smallest being no larger than the nucleolus of a mature ovum. But Carpenter was unable to make out the derivation of these germs from the epithelial cells as clearly as may be seen in *Heliometra glacialis* and similar forms.

The lateral branches of the axial cords of the arms are especially well developed in this species.

Localities.—Long Island, Abrolhos (Houtman's Rocks), Western Australia [H. L. Clark, 1923].

Mer, Murray Islands, Torres Strait; October, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 578).

Dobo Strait, Aru Islands; 20 meters; coarse shell sand [Reichensperger, 1913].

Bay of Amboina; MM. Bedot and Pictet [Koehler, 1895].

Ternate [Pfeffer, 1900].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 14; about 40 meters; sand; April 10, 1922 (1); station 26; about 90 meters; sand; April 16, 1922 (1); station 31; about 50 meters; sand; April 19, 1922 (1); station 40; about 20 meters; sand; April 25, 1922 (1); station 53; 85 meters; sand and coral; May 9, 1922 (1).

Siboga station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; January 15–17, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 99; anchorage off North Ubian (lat. 6° 07′ 30″ N., long. 120° 26′ 00″ E.); 16–23 meters; lithothamnion bottom; June 28–30, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 43; anchorage off Pulu Sarassa, Postillon Islands; down to 36 meters; coral bottom; April 4–5, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Enkhuizen Island, near Batavia, Java [A. H. Clark, 1918] (1, Amsterdam Mus.).

Southern portion of Malacca Strait [A. H. Clark, 1912] (1, I. M.). Pl. 3, fig. 3.

Albatross station 5147; in the vicinity of Siasi, Jolo (Sulu) archipelago; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand, and shells; February 16, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 34484, 34490). Pl. 1, fig. 1.

Albatross station 5146; in the vicinity of Siasi, Jolo (Sulu) archipelago; Sulade Island (E.) bearing N. 18° W., 3.4 miles distant (lat. 5° 46′ 40″ N., long. 120° 48′ 50″ E.); 44 meters; coral sand and shell; February 16, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34488).

Albatross station 5136; near Jolo (Sulu), Philippine Islands; Jolo Light bearing S. 37° E., 0.7 mile distant (lat. 6° 04′ 20″ N., long. 120° 59′ 20″ E.); 41 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34487).

Albatross station 5145; near Jolo (Sulu); Jolo Light bearing S. 16° E., 0.85 mile distant (lat. 6° 04′ 30″ N., long. 120° 59′ 30″ E.); 42 meters; coral sand, and shells; February 15, 1908 [A. H. Clark, 1908] (5, U.S.N.M., 34485, 36228, 36248).

Albatross station 5139; near Jolo (Sulu); Jolo Light bearing S. 51° W., 3.6 miles distant (lat. 6° 06′ 00″ N., long. 121° 02′ 30″ E.); 36 meters; coral sand; February 14, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 34486, 34489).

Albatross station 5142; near Jolo (Sulu); Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 00″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand, and shells; February 15, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34491).

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; off Jolo (Sulu); about 18 meters; sand and coral; March 17, 1914 (2); about 36 meters; March 21, 1914 (2); about 36–55 meters; sand and coral; March 19, 1914 (1).

Albatross station 5253; Gulf of Davao, Philippines; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 34492). Pl. 2, fig. 2.

Albatross station 5356; North Balabac Strait, Philippine Islands; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long. 117° 18′ 45″ E.); 106 meters; sand and shells; January 5, 1909 [A. H. Clark, 1911] (1 U.S.N.M., 34493).

Albatross station 5413; between Cebu and Bohol, Philippines; Lauis Point Light bearing N., 68° W., 10 miles distant (lat. 10° 10′ 35″ N., long. 124° 03′ 15″ E.); 77 meters; March 24, 1909 [A. H. Clark, 1911] (1 U.S.N.M., 34494).

Bohol, Philippines; Prof. C. Semper [Ludwig, 1876; W. B. Carpenter, 1876; P. H. Carpenter, 1876, 1881, 1884, 1887, 1888; von Graff, 1877, 1884; Braun, 1888; Rolleston and Jackson, 1888; Hamann, 1889; Koehler, 1895; A. H. Clark, 1908, 1912].

Bantayan Reef, Cebu, Philippines (14, M. C. Z., 378, 389, 390).

Port Galera, Mindoro, Philippines [H. L. Clark, 1921] (26, M. C. Z., 625, 638, 639, 643, 644, 646).

No locality [A. H. Clark, 1913] (1, B. M.)

Geographical range.—From Torres Strait, northeastern Australia, and the Abrolhos Islands, Western Australia, northward to the Philippines and westward to Sumatra.

Bathymetrical range.—From the shore line down to 106 meters.

Occurrence.—At Mer Dr. H. L. Clark found this species only near the outer margin of the southwestern reef flat, and on Bantayan Reef, Cebu, Dr. L. E. Griffen found specimens attached to the roots and stems of gorgonians.

In dredging operations this species has only been found on bottoms of lithothamnion or coral, or coral sand and shells.

History.—Beginning in 1876 this species was frequently mentioned in papers by Ludwig and by W. B. and P. H. Carpenter dealing with the anatomy of the crinoids, but no indications were given of the characters by which it might be distinguished from other species. In 1877 von Graff described the myzostomes found upon it. The material upon which all these references were based had been collected at Bohol, in the Philippine Islands, by Prof. Carl Semper.

In 1888 Dr. P. H. Carpenter inserted the specific name *nigra* in his key to the species of the "*Stelligera* group" of *Actinometra*. He gives as the distinctive features the partial visibility of the radials and entire visibility of the IBr_1 and the occurrence of three "postdistichal axillaries."

In 1895 Professor Koehler recorded this species, under the name of *stelligera*, from the Bay of Amboina, and quoted Carpenter as saying that *nigra* is a synonym of *stelligera*, though I can not find that Carpenter ever made the statement.

On February 14–16, 1908, the *Albatross* dredged a number of specimens of this species in the region of Jolo. These were recorded in a paper published by the present author on December 23, 1908, in which a short description of the species was given. Other specimens collected by the *Albatross* in the Philippines were recorded in 1909 and in 1911, a specimen from the Malacca Strait in 1912, and one without locality in the British Museum collection in 1913.

Dr. A. Reichensperger in 1913 recorded a large specimen from the Aru Islands, and in 1915 Dr. H. L. Clark recorded 2 from Mer in Torres Strait.

In 1918 the present author recorded it from various East Indian localities, where it had been dredged by the *Siboga*.

Dr. H. L. Clark in 1921 recorded it from Mer and from Port Galera, Mindoro, and in 1923 he recorded it from the Abrolhos Islands, Western Australia.

COMATELLA STELLIGERA (P. H. Carpenter)

Plate 4, Figures 6–9

[See also vol. 1, part 1, fig. 51 (pinnule tip), p. 81; fig. 230 (ventral view of centrodorsal), p. 247; fig. 448 (dorsal view of radial pentagon), p. 353; pt. 2, figs. 154, 155 (analysis of arm division), p. 83; figs. 597–599 (comb), p. 309; pl. 1, figs. 950–952 (centrodorsal and radials); pl. 12, fig. 1041 (portion of arm); pl. 23, fig. 1144 (abnormal disk)]

Actinometra tenax Lütken, Mus. Godeffroy Cat., vol. 5, 1874, p. 190 (Samoa; Fiji; *nomen nudum*).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29, footnote 3 (named but not described by Lutken); p. 45 (2 palmars on 2 distichals in this species).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 308 (synonym of *stelligera*).—Koehler, Revue suisse de zool., vol. 3, 1895, p. 293 (same).—A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (same).

Actinometra, sp. P. H. Carpenter, Pop. Sci. Revue, vol. 4, No. 15, 1880, p. 194, footnote (with 2 mouths and 2 anal tubes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 294 (Mergui).

Actinometra stelligera P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 15, 1880, p. 198 (centrodorsal and radial articular faces); pl. 12, fig. 26 (*Challenger* station 174; same); Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula); *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, pp. 69, 70, 337 (discussion); pl. 56, fig. 8 (disk with 2 mouths and 2 anal tubes); vol. 26, pt. 60, 1888, p. 308 (description; station 174, B, C, or D; also Tonga, Fiji, Samoa, Reef of Atagor); p. 309 (Zebu); pl. 5, figs. 5*a*–*d*; pl. 58, figs. 1, 2.—Hartlaub, Nova Acta Acad. German, vol. 58, No. 1, 1891, p. 104 (Samoa and Fiji; Ovalau; characters of the last); p. 113 (in Göttingen Mus.).—Koehler, Revue suisse de zool., vol. 3, 1895, p. 293 (discussion, but not specimen recorded).—Minkert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. I, Heft 1, p. 198 (syzygies; regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, pp. 35, 37 (identity of Carpenter's and Hartlaub's records).

Antedon tenax von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 13, 19, 33 (New Holland; myzostomes).—Braun, Centralbl. f. Bakteriol- u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; from von Graff).

Actinometra notata Bell, Proc. Zool. Soc. London, 1888, p. 389, footnote 5 (collected by Dr. Anderson at Mergui; *nomen nudum*).—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 305 (specific formula); p. 312 (King I., sublittoral; detailed description and comparisons).—Chadwick, Report Ceylon Pearl Oyster Fisheries, pt. 2, Suppl. Rep. 11, 1904, p. 153 (occurs at Ceylon); p. 157 (Sta. LIV; characters).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, pp. 36, 40 (identity of Carpenter's and Chadwick's records).

Actinometra stilligera MacMunn, Quart. Journ. Microsc. Sci., 1890, p. 60 (coloring matter).

Antedon bassett-smithi Bell, Proc. Zool. Soc. London, 1894, p. 393 (irregularity in the position of the syzygies); p. 396 (Macclesfield Bank, 13–36 fms.); p. 399 (description); pl. 24.—A. H. Clark, Smiths. Miscell. Coll., vol. 50, part 3, 1907, p. 363 (wrongly described in the *Spinifera* group; here referred to the *Multicolor* group); Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 437, 460 (wrongly described in the *Spinifera* group; belongs in the *Palmata* group; discrepancies between the figures and description); vol. 36, 1909, p. 395 (identified as *Comatella stelligera;* belongs in the *Stelligera* group of *Actinometra*); Crinoids of the Indian Ocean, 1912, p. 38 (=*stelligera*).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 309 (in *Spinifera* group; history; discussion); p. 310 (characters).—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 80 (=*stelligera*).

Actinometra simplex Bell, Proc. Zool. Soc. London, 1894, p. 396 (Macclesfield Bank, 13 fms.).

Actinometra maculata Bell, Proc. Zool. Soc. London, 1894, p. 395 (Parry's shoal, 12 fms.); p. 396 (Macclesfield Bank; same, 13–36 fms.).

Calometra bassett-smithi A. H. Clark, Smiths. Miscell. Coll. (Quarterly Issue), vol. 50, part 3, 1907, p. 363 (listed).

Comatula notata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (listed); vol. 35, 1908, p. 124 (listed).

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Diagnostic features.—The size is medium to rather large; the cirri have 18–26 (usually 20–25) segments and are from 15 to 25 mm. (usually from 15 to 20 mm.) in length; there are 27–50 (usually 30–40) arms, which are from 90 to 120 mm. long; IIIBr series are usually present on the outer derivatives from each IIBr axillary, the inner derivatives remaining undivided.

Description.—The centrodorsal is a broad, flat, moderately thick disk, with the broad polar area flat and about 5 mm. in diameter. The cirrus sockets are arranged in 3 closely crowded alternating rows.

The cirri are XXVII–XXXVII (usually about XXX), 18–26 (usually 20–25; the variation in any individual is not more than from 4 to 6 segments, and usually only 2 or 3), from 15 to 25 mm. long, the cirri in each specimen averaging usually about 15 or 20 mm., most commonly the latter. The first segment is very short, and the following increase in length to the fourth, which is a little longer than broad, and the fifth-seventh or sixth-eighth, which are the longest, one-third, sometimes nearly one-half, again as long as broad. The eighth, ninth, or tenth, rarely the eleventh, twelfth, or thirteenth, is a transition segment which is about as long as broad or slightly longer than broad, with the greater part of its surface dull like that of the preceding segments, but the distal portion highly polished like those succeeding. The following segments are at first about as long as broad, then gradually decreasing in length so that the last 9 or 10, which are somewhat compressed laterally, are twice as broad as long, or even broader distally. The transition and following segments have a slight dorsal tubercle which is at first distal in position but gradually moves proximally, becoming submedian after 7 or 8 segments and median on the last 4 or 5. The opposing spine is represented by a slight median tubercle. The terminal claw is longer than the penultimate segment and is stout and strongly curved.

The radials are nearly or quite concealed by the centrodorsal.

The IBr_1 are very short, closely united laterally, proximally more or less concealed by the centrodorsal. The IBr_2 are short and broad, somewhat over twice as broad as long, triangular, and laterally free. The IIBr series are 2, almost invariably all present. The IIIBr series are 2, usually all present, developed on the outermost side of each postradial series in 2, 1, 1, 2 order. IVBr series and even VBr series are sometimes present, always developed exteriorly in reference to the IBr series, like the IIIBr series. The division series are strongly rounded dorsally and laterally, and are perfectly free laterally, though not very widely separated. The first segments following each axillary are interiorly united for rather more than one-half their internal length, but widely separated distally.

Arms 27–50 (usually 30–40), from 90 to 120 mm. in length, composed of about 120 brachials. The first 2 brachials are similar in size and shape, small, short, and wedge-shaped. The next 4 or 5 brachials are oblong, approximately twice as broad as long, and the following become triangular, at first nearly as long as broad, but decreasing gradually in length and in obliquity and in the outer half of the arm becoming very short and disicoidal and resembling the distal brachials in *Himerometra*. All the brachials following the few oblong brachials at the base of the arm have prominent and somewhat overlapping distal ends and a longitudinally striate dorsal surface.

Syzygies occur between brachials 1+2, except on the outermost arms of each postradial series, 3+4, this being usually omitted if the 2 preceding brachials are united by syzygy, and from 11+12 to 16+17; the distal intersyzygial interval is 4, rarely 3, muscular articulations.

P_1 is moderately stout basally, but becoming slender and flagellate in the distal half, from 15 to 18 mm. long; the terminal comb has about 15 teeth, which are triangular, approximately equilateral, slightly incurved, and about equal in height to the width of the segments that bear them. P_2 is not quite so stout basally as P_1, and is 13 or 14 mm. in length. P_4 and the following pinnules are about 8 mm. long, and bear long gonads. The distal pinnules are from 8 to 9 mm. long. The 2 basal segments of P_2, P_3, and P_4 are very strongly carinate.

The mouth is usually radial and is marginal or situated about half way between the center and the periphery of the disk. The anal area is naked, irregularly studded with large thick concretions, or entirely covered with smaller irregular plates each of which bears several blunt tubercles. The disk is from 15 to 20 mm. in diameter.

Color of preserved specimens.—The green specimen which served as the subject for a colored illustration by Dr. H. L. Clark (1921, pl. 2, fig. 2) has in alcohol changed to a uniform dark brown. Another recorded in Doctor Clark's notes as purple and green with the tips of the pinnules rusty changed when dried to a uniform olive green, as did a third, which in life was yellow green and blackish. One recorded as rich red purple and very viscid when alive as dried is a light uniform slaty.

The color in alcohol or dried is reddish or blackish brown or dull green or slaty, usually more or less profusely speckled with small yellow or whitish spots.

Notes.—In the specimen recorded by Chadwick from Ceylon there are 20 arms and XX cirri, 8 of the last being quite small and immature.

The specimen from Ceylon collected by Doctor Sarasin has about 35 arms, which are about 110 mm. in length.

The specimen in the Indian Museum labeled "?India," which probably came from Ceylon, is a beautiful example with 31 arms 110 mm. long; 4 internal and 7 external IIIBr series are present. The cirri are 25 mm. long.

The 3 specimens which were collected by Dr. John Anderson in the Mergui Archipelago served Dr. P. H. Carpenter as the types of *Actinometra notata*. His description of this species agrees in minute detail with the description here given, except that the length of P_1 on the outermost arms of each ray is nearly 40 mm.

In the smallest of these 3 specimens the disk is entirely naked instead of bearing calcareous granules in the anal interradius as usual.

The specimen from Padaw in the Mergui Archipelago has 34 arms and agrees well with the types of Carpenter's *notata*.

The specimen from the Sunda Straits is young with 15 arms 65 mm. long; the cirri are XXIV, 17–18, 15 mm. long.

The specimen from *Siboga* station 322 has 33 arms 170 mm. long and the cirri XVIII, 21–23, 25 mm. long; the ninth is the transition segment. The whole animal is large and robust.

The larger specimen from *Siboga* station 99 has 37 arms (on the 5 rays 6, 6, 9, 7, 9) 95 mm. in length; the cirri are XXV, 25–26 (usually 25), from 20 to 23 mm. long and moderately slender; the twelfth, thirteenth, or fourteenth is a transition segment. The smaller specimen has 31 arms.

The specimen from *Siboga* station 89 is small, with 30 arms.

The example from off Neira, Banda, has 45 arms 110 mm. long; the cirri have 21–25 segments.

The specimen from the Danish Expedition to the Kei Islands station 17, apparently of this species, is small with 10 arms. The centrodorsal is thin discoidal with the dorsal pole flat, 3 mm. in diameter; the cirrus sockets are arranged in a single slightly irregular marginal row. The cirri which still remain are VII, 15–16, from 13 to 15 mm. long; the sixth is a transition segment.

In the specimen from the Danish Expedition to the Kei Islands station 24 the centrodorsal is thin discoidal, with a broad flat dorsal pole 4 mm. in diameter. The cirrus sockets are arranged in a partially double crowded and somewhat irregular marginal row.

The cirri are XXV, 20–21, 20 mm. long, with the distal half rather strongly recurved. The first segment is very short, the second is from half again to twice as broad as long, the third is about as long as broad, the fourth is longer, and the fifth is the longest, nearly twice as long as broad, and is a more or less marked transition segment. The following segments decrease in length so that the last 12 are broader than long. The transition and following segments have the dorsal portion of the distal edge slightly produced and armed with very fine spines. Distally this production gradually narrows and increases in height and at the same time the distal border transforms from a straight line to a deeper and deeper V. On the short outer segments the dorsal surface may be sharply carinate in the middorsal line. In lateral view the dorsal profile of the cirri following the transition segment is at first gently serrate, the apices of the serrations being near the distal ends of the segments, but on the last 5 or 6 segments it becomes scalloped rather than serrate. The opposing spine is low, conical, arising from the entire dorsal surface of the segment, with the apex median or subterminal. The terminal claw is slightly longer than the penultimate segment and is stout and only moderately curved.

The 12 arms are 140 mm. long. The two IIBr series, both on the same postradial series, are 2. Following both the inner derivative has the first 4 brachials united in 2 syzygial pairs, while on the outer derivative the first and second brachials are united by synarthry, the third and fourth by syzygy.

The example from Wooded Isle, Abrolhos Islands, has 25 arms which are about 90 mm. long. The cirri are XXX, 19–22. The disk is 25 mm. in diameter.

The specimen from the Sahul Bank is very small, and is remarkable for its unusually large cirri. The arms on the 5 rays are 7, 7, 6, 6, 4 = 30.

Of the specimens from Mer which I have personally examined, one has 36 arms and the cirri XXIII, 23; another has 39 arms and the cirri XXIV, 24; and the remainder have 35, 39, and 43 arms, those of the last being about 100 mm. long.

The specimen from New Guinea in the Berlin Museum is small, with 30 arms; the cirri are XIV, 19–21.

The example labeled "Samoa and Fiji," in the British Museum, has 33 arms; all the division series are external in reference to the IBr series. The 2 with the same label in the Hamburg Museum each have 30 arms.

In the specimen from Ovalau, Fiji, P_1 is about 25 mm. long.

Of 2 examples from the Tonga Islands, in the Copenhagen Museum, one has 30 arms 90 mm. long, and the cirri XXX, 20–26 (usually 23–25), from 15 to 25 mm. in length; the transition segment is about the thirteenth. The other (dry) has 31 arms, all of which are broken off near the base; the cirri are XXXVII, 18–21 (usually 20).

A specimen from Samoa in the Copenhagen Museum has 27 arms 100 mm. long and the cirri XXVII, 20–22, from 15 to 20 mm. in length; the transition segment is about the tenth. The brachials in the distal half of the arm are exceedingly short, almost discoidal. Eggs are developed on the pinnules.

Of the examples from *Siboga* station 96, the largest has 43 arms 100 mm. long, and the cirri from 22 to 26 mm. long with 23–25 segments; the dorsal pole of the centrodorsal is very slightly concave, 3.5 mm. in diameter. Another has 43 arms about 85 mm. long, and the cirri from 20 to 22 mm. long with 24–26 segments, of which the eleventh, twelfth, or thirteenth is a transition segment. A third is similar to the preceding with 35 arms 95 mm. long and the cirri from 20 to 23 mm. long. A fourth has 33 arms 95 mm. long and cirri XX, 22–24, from 28 to 29 mm. long; the ninth or tenth is a transition segment. A fifth has 29 arms 80 mm. long; on the several rays the arms are 8 (4+4), 4 (1+3), 7 (4+3), 8 (3+5), and 2; the anal area of the disk is studded with scattered large rounded conical concretions. The remaining specimen is young, with 12 arms 40 mm. long.

Of the two specimens from off Jolo, one is rather large and stout, approaching *C. nigra.* There are 38 arms 130 mm. long. The cirri have 24–27 segments. The other is smaller and less stout with about 35 arms 105 mm. long. The cirri have 19–23 segments.

The specimen from Port Galera, Mindoro, has 21 arms.

The specimen from the Philippines collected by Prof. J. B. Steere is small and mutilated; it has between 40 and 50 arms.

The example from Macclesfield Bank without further data has 26 arms; the cirri are X, 18. That from 24 meters has 20 arms and its cirri have 18 segments. One of the 2 from 24–66 meters has 20 arms 80 mm. long; the cirri are XXII, 18–20 (usually the latter), 18 mm. long; the centrodorsal has a broad flat dorsal pole 5 mm. in diameter.

The specimen from Parry's shoal in 22 meters has 21 arms 90 mm. long; the cirri are XXV, 17–20 (usually the latter), from 15 to 18 mm. in length. This is very like the individual from the Macclesfield in 24 meters, but the whole animal is a trifle stouter.

The example possibly from the Chinese coast was simply labeled in Chinese characters "very deep water." This is the only indication of its origin. The centrodorsal is thick discoidal with a flat dorsal pole 4.5 mm. in diameter; the cirri are XVIII, 20–21, 20 mm. long. There are 38 arms about 80 mm. long; the distal edges of the brachials are produced and finely spinous, and the distal ends of the elements of the division series are prominent, these 2 features together giving the animal a very rugose appearance.

One of the specimens from Doctor Bock's station 59 in the Bonin Islands has the centrodorsal 3.7 mm. in diameter, the bare dorsal pole being 2 mm. in diameter. The cirri are XXVIII, 20–24, from 15 to 20 mm. long, arranged in 2 rows. In the cirri the first 2 segments are broader than long. The third is somewhat longer, slightly constricted centrally, and the fourth–sixth are half again as long as broad. The seventh is a transition segment, and the surface of the eighth and following is highly polished. From the seventh onward a small dorsal spine is developed, which at first consists of a minute transverse spiny ridge narrowing on about the eleventh to a simple terminal spine. The distal cirrus segments are from one-half to one-third again as broad as long, the length of their dorsal spines being from one-quarter to one-third the width of the segments.

The opposing spine is a little smaller and sharper than the spine preceding. The terminal claw is two-thirds again as long as the penultimate segment and curved.

The radials are visible as narrow bands. The IBr_1 are three times as broad as long and are united proximally. Like all the ossicles in the proximal portion of the arms, they have the ends somewhat thickened and everted and finely spinous. There is a distinct synarthrial tubercle. The IBr_2 (axillaries) are triangular or low pentagonal, three times as broad as long.

The 18 arms are 80 mm. long. After the seventh the brachials have oblique ends which are thickened, overlapping, and spinous.

In some exceptional cases brachials 1+2 and 3+4 are united by syzygy on the inner arms. The distal intersyzygial interval is 5 or 6 muscular articulations.

Combs extend as far as P_5 or P_6. P_1 is 9.5 mm. long with about 37 segments, of which 17 or 18 bear teeth. P_3 is 6.5 mm. long with about 35 segments, of which about 20 bear teeth. P_4 has 37 segments, of which the eleventh and following bear teeth. P_5 has about 30 segments, of which the twelfth and following bear teeth. P_6 is 4.5 mm. long with 28 segments, of which 15 bear teeth, or with 17 segments and no comb. The teeth of the combs are narrow and fairly high, the height reaching about two-thirds the width of the segments. P_7 is 4.2 mm. long with 16 segments, and P_8 is the same length with 15 segments which are not longer than broad; the proximal segments bear a spinous carination. The distal pinnules are 5 mm. long with 18–20 segments, of which the terminal 4 or 5 have paired dorsal hooks.

The disk is 10 mm. in diameter and the anal tube is 2.5 mm. high. The mouth and anus are subcentral. There are no calcareous granules.

The second specimen from station 59 has 16 arms 65 mm. long; 6 of these are young regenerating arms. The cirri are XX, 14–18, from 6 to 12 mm. long, in 1 and an incomplete second row. The combs extend to P_4. P_1 is 6 mm. long with 31 segments, of which 15 bear teeth. P_2 is 5 mm. long with 30 segments, of which 17 bear teeth. P_4 is 4.2 mm. long with 23 segments, of which 14 bear teeth. The teeth are narrow and pointed. P_5 is 4 mm. long with 13 teeth. The proximal portion of the arms is somewhat smoother than is the case in the preceding specimen.

Gislén also refers to this species a 10-armed specimen from this station which differs from those described chiefly in being smaller.

In a specimen from station 56 the centrodorsal is only very slightly convex, 1 mm. in diameter. The cirri are XXV, 16 (the dorsal 13), from 6 to 9 mm. in length, arranged in 2 rows. Three of the cirri are very small. In the cirri the first 2 segments are short, the third is half again as long as broad and slightly constricted centrally, and the fifth and sixth are twice as long as broad, with expanded distal ends. The sixth has a spinous transverse ridge, which on the segments following narrows and on the tenth becomes a simple dorsal spine equal in height to one-quarter the width of the segment. The terminal claw is half again as long as the preceding segment, blunt, and somewhat curved.

The IBr_1 are three times as long as broad, and are basally separated laterally by the anterolateral angles of the radials. The IBr_2 (axillaries) are low pentagonal, three times as broad as long, with the anterior angle obtuse. The articulation between the elements of the IBr series is close, and there is a slight synarthrial tubercle.

The first 2 brachials are closely united laterally. The first 6 brachials are short and discoidal, but the ends of those following become oblique. The distal edges of the outer brachials are much everted and finely spinous. The distal intersyzygial interval is 4–6 muscular articulations.

The first 5 pinnules bear combs. P_1 is 6.5 mm. long with 32 segments, of which 18 bear teeth. P_2 is 5 mm. long with 31 segments, of which 18 bear teeth. P_3 is 4 mm. long with 24 segments, of which 15 bear teeth. P_4 is similar to P_3. P_5 is 3.5 mm. long with 24 segments, of which 14 bear teeth. The distal pinnules are 4.5 mm. long with about 17 segments, of which the distal bear dorsal hooks.

The mouth and anal tube are subcentral. The color in alcohol is yellow brown with white spots; the cirri are white.

In the specimen from station 43 the cirri are XVIII, 14–17, from 6 to 10 mm. in length. Dorsal spines are developed from the sixth segment onward.

There are 12 arms 55 mm. in length. The distal intersyzygial interval is 3 or 4 muscular articulations.

P_1 and P_2 have long combs composed of 15–20 teeth. P_1 is 5.5 mm. long, and P_2 is 4.5 mm. long. P_5 is 3 mm. long, its comb with about 10 teeth. P_6 has no comb. The distal pinnules are 4 mm. long with 13 segments.

The disk is 4 or 5 mm. in diameter; the mouth and anus are subcentral.

The color is brownish green, the skeleton lighter, olive brown.

Doctor Gislén remarks that the young individuals of *C. stelligera* and *C. maculata* are very similar and probably can not be distinguished from each other. He says that presumably they pass through a stage in which the cirri are formed like those of *C. brachycirra*.

The specimen in the Australian Museum labeled "Port Jackson" has 36 arms, which were originally about 90 mm. long. The cirri are XXII, 18–20, 20 mm. long. The eversion of the distal edges of the brachials is especially well marked, and there is an indication of an eversion of the distal edges of the elements of the division series.

Abnormalities.—In one of the specimens secured by the *Challenger* there are 2 mouths and 2 anal tubes. The true mouth is interradial, and there is a large subcentral anal tube immediately behind it. But there is also a second anal tube occupying the interval between the posterior ambulacrum which curves around the left-hand portion of the disk and the branches of the lateral ambulacrum on its right-hand side. This is very irregular in character, and at one portion of its course expands into a second peristome in which there is a small mouth. The figure of the disk of this specimen published by Carpenter in 1880 was republished in 1884.

Carpenter noticed that the arrangement of the ambulacra in one of the specimens collected by Dr. John Anderson in the Mergui Archipelago is very singular. The mouth seems to be radial, and the number of groove trunks connected with the peristome is very considerable. The aboral portion of the left anterolateral ray, which includes the arms borne upon its posterior IIBr axillary, has an altogether abnormal groove supply. The ambulacra of its anterior arms are directly connected with the peristome, as is often the case. But the ambulacrum proceeding in this direction from the left posterior angle of the peristome comes to a sudden end on the disk immediately after its first bifurcation, and all the ambulacral grooves of the corresponding ray (the left posterior), together with those of the posterior arms on the left anterior ray, are connected with the single groove trunk which curves around the right side of the disk to supply the hinder arms of the right posterior ray. Carpenter suggests that parasites may have been originally responsible for this condition.

In Sarasin's specimen from Ceylon one of the axillaries bears 2 pinnules instead of the usual 2 arms.

In another *Challenger* specimen the anal tube is close up to the peristome a little to one side of the median line instead of being central, as is usually the case.

Carpenter noticed in a third *Challenger* specimen that on the outermost arm on one ray the first 2 brachials are united by synarthry, whereas in the other arm borne on the same IIBr axillary and in 3 similar arms of the adjacent ray these 2 brachials are united by syzygy. This, however, is a more or less frequent variation rather than an abnormality.

Localities.—Ceylon Pearl Fisheries Investigations station LIV; northern part of the Gulf of Manaar, south of Adam's bridge; 7–73 meters; bottom varied, from sand to living coral [Chadwick, 1904].

Ceylon; Doctor Sarasin, 1886 [Reichensperger, 1913; H. L. Clark, 1915].

?India (probably Ceylon) [A. H. Clark, 1912] (1, I. M.). Pl. 4, fig. 7.

King Island, Mergui Archipelago; sublittoral; Dr. John Anderson [P. H. Carpenter, 1888, 1889; Bell, 1888].

Padaw, Mergui Archipelago [A. H. Clark, 1912] (1, U.S.N.M. 34495). Pl. 4, fig. 6.

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 74; Sunda Strait; 30 meters; stones and shells; July 29, 1922 (1).

Siboga station 322; 1.5 miles south of Tandjong Lajar, on the southern coast of Bawean Island, north of Java; 32 meters; coral; February 24, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.)

Siboga station 99; anchorage off North Ubian (lat. 6° 07′ 30″ N., long. 120° 26′ 00″ E.); 16–23 meters; lithothamnion bottom; June 28–30, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 89; Pulu Kaniungan ketjil; 11 meters; coral bottom; June 21, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; off Neira, Banda; about 20 meters; sand; June 1, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 17; 100 meters; sand and shells; April 12, 1922 (1); station 24; 100 meters; hard bottom; April 15, 1922 (1).

Australia [von Graff, 1884].

Wooded Isle, Abrolhos Islands, Western Australia [H. L. Clark, 1923].

Sahul Bank [A. H. Clark, 1929] (1, B. M.).

Mer, Murray Islands, Torres Strait; October, 1913 [H. L. Clark, 1915, 1921] (36, M. C. Z., 512, 513, 514, 515, 556, 557).

Mer, southwest reef; September 30, 1913 [H. L. Clark, 1915, 1921] (2, M. C. Z., 511).

Reef of Atagor; Prof. J. Beete Jukes, H. M. S. *Fly*, 1843–'47 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Off Ellison reef, outer Great Barrier reef, Queensland; 9–27 meters; August 1924; Surgeon Lieut. Comdr. W. E. J. Paradice, R. A. N.; H. M. S. *Geranium* [H. L. Clark, 1926].

Surprise shoal, outer Great Barrier reef (about lat. 18° S.); 13 meters; 1924; Surgeon Lieut. Comdr. W. E. J. Paradice, R. A. N.; H. M. S. *Geranium* [H. L. Clark, 1926].

New Guinea [A. H. Clark, 1912; Hartmeyer, 1916] (1, Berl. Mus., 6378).

Fiji [Lütken, 1874; P. H. Carpenter, 1888; Hartlaub, 1891; A. H. Clark, 1912, 1913].

Ovalau Island, off the eastern coast of Viti Levu, Fiji [Hartlaub, 1891].

Tonga Islands [P. H. Carpenter, 1888; A. H. Clark, 1909] (2, C. M.).

Tonga Islands; Maka Hua, Tongatabu; Prof. W. A. Setchell, July 15, 1926 (2, U.S.N.M., E. 1262).

Samoa [Lütken, 1874; P. H. Carpenter, 1888; Hartlaub, 1891; A. H. Clark, 1909, 1912, 1913] (2, C. M.). Pl. 4, figs. 8, 9.

Samoa or Fiji [A. H. Clark, 1913] (3, B. M., H. M.).

Siboga station 96; Sulu (Jolo) archipelago; southeastern side of the Pearl bank; 15 meters; lithothamnion bottom; June 27, 1899 [A. H. Clark, 1918] (6, U.S.N.M, E. 462; Amsterdam Mus.).

Dr. Th. Mortensen's Pacific Expedition, 1914–16; off Jolo (Sulu); coral reef; March 20, 1914 (2).

Cebu, Philippines [P. H. Carpenter, 1888].

Port Galera, Mindoro, Philippines; Dr. L. E. Griffin (1, M. C. Z., 647).

Philippines; J. B. Steere (1, U.S.N.M., 36169).

Macclesfield Bank [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Macclesfield Bank; 24 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Macclesfield Bank; 24–66 meters [Bell, 1894; A. H. Clark, 1913] (2, B. M.).

Parry's Shoal, near Macclesfield Bank; 22 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

?Chinese coast; "very deep water" [A. H. Clark, 1912] (1, H. M.).

Dr. Sixten Bock's station 59; Bonin Islands; eastnortheast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 56; Bonin Islands; east of the channel; 210 meters [Gislén, 1922].

Dr. Sixten Bock's station 43; Bonin Islands; northwest of Ototojima; 146 meters; July 31, 1914 [Gislén, 1922].

Doubtful localities.—Challenger station 174, B, C, or D; near Kandavu, Fiji (lat. [about] 19° 06′ S., long. [about] 178° 18′ E.); 384, 466 or 1,115 meters [P. H. Carpenter, 1880, 1888; A. H. Clark, 1913] (3 M., C. Z., 210; B. M.).

Port Jackson, New South Wales [A. H. Clark, 1911] (1, Austr. Mus.).

Geographical range.—From Ceylon and the Mergui Archipelago to the Macclesfield Bank, the Philippines, the Bonin Islands, Samoa, Fiji, Tonga, and northern Australia, south on the east to Surprise shoal (about lat. 18° S.) and on the west to the Abrolhos Islands (Houtman's rocks). ?Coast of China.

Bathymetrical range.—From the shore line down to 32 (?73) meters, and undoubtedly somewhat deeper. The depths at Dr. Sixten Bock's stations represent the length of line out and not the actual depths.

Occurrence.—Dr. H. L. Clark noted that this species is very common at Mer, especially on the southwestern reef flat.

It has always been found in association with the coral reef fauna, in shallow water on the reefs themselves, and in deeper water on coral, lithothamnion, or coral sand bottoms.

Remarks.—Like the other species of comatulids recorded by Carpenter from *Challenger* station 174, B, C, or D, the specimens listed from that station were probably taken in shore collecting.

There is no reason to believe that this species is to be found in the region of Port Jackson, New South Wales. The comatulid fauna of this district, as repeatedly reported, consists only of *Comanthus trichoptera*, *Compsometra lovéni*, and *Ptilometra australis*, none of which occur at any place within the range of *C. stelligera*.

History.—The first known specimen of this species was secured by Mr. J. Beete Jukes, the naturalist of H. M. S. *Fly*, during the investigations in the northeast Australian region in 1843–1847.

In the late sixties and early seventies a number of specimens of this species from Samoa, Fiji, Tonga, and Australia were brought to Hamburg by the Godeffroy Co. Here the name *Actinometra tenax* was bestowed upon them by Prof. C. F. Lütken, and under this name they were distributed to various European museums.

Professor Lütken intended formally to describe this species, but he never did this, and the only mention he ever made of the name was to list it in one of the catalogues of the Godeffroy Museum published in 1874.

In 1879 Dr. P. H. Carpenter mentioned that Lütken had applied the name *Actinometra tenax* to a species of which he never had had the opportunity of examining specimens; but later in the same paper he remarked that this species (*tenax*) is characterized, together with a few new *Challenger* species, by the possession of "two palmars on two distichals" (that is, by having both IIBr and IIIBr series 2), so that he must have seen specimens while the preparation of the article was in progress.

In 1880 Carpenter figured a comasterid disk with 2 mouths and 2 anal tubes; he refers this merely to "*Actinometra*, sp." He mentioned, however, that the specimen came from the *Challenger* collection, and in the *Challenger* report we find the same figure republished under the name of *Actinometra stelligera*.

In another paper published in the same year dealing with the fossil genus *Solanocrinus* and its relations to recent comatulids Carpenter figured the centrodorsal and radial articular faces of a comasterid from *Challenger* station 174 to which he refers in the text and in the explanation to the plates as belonging to *Actinometra stelligera*, n. sp.

The figure does not show any characters by which this may be separated from related species, and Carpenter gives no differential characters in the text; but technically this mention of this form constitutes the original description.

This figure of the centrodorsal and the radial articular faces was reprinted in the *Challenger* report.

In 1884 Prof. Ludwig von Graff described the myzostomes found on a comasterid in the Copenhagen Museum from New Holland (Australia) which he recorded under the name of *Antedon tenax.* I have not seen this specimen, which was presumably one of the earlier ones brought to Europe by the Godeffroy Co. and named by Lütken before he had discovered the difference between *Antedon* and *Actinometra;* that is, in the late sixties.

In the *Challenger* report on the stalked crinoids (1884) Carpenter described the distribution of the ambulacral grooves on the disk in *Actinometra stelligera*, using it, together with *Actinometra magnifica*, as typical of comasterids with an interradial mouth. He diagnosed *Actinometra stelligera* by giving its "specific formula" in a footnote. He also redescribed the specimen with 2 mouths and 2 anal tubes, republishing the figure which originally appeared in 1880. Further on he lists 8 groups (A–H) of the genus *Actinometra*, and cites *Actinometra stelligera* as typical of group F, which is characterized by having "two palmars, the axillary not a syzygy," that is, the IIIBr series 2.

In the *Challenger* report on the comatulids (1888) Carpenter gave a detailed description of this species based on 7 specimens brought back by the *Challenger*, and recorded it also from Tonga, Fiji, Somoa, and the reef of Atagor. While this volume was going through the press and after some of the plates illustrating the structure of this form had been printed Carpenter found that his *stelligera* was apparently identical with the form which had been distributed by the Godeffroy Museum under the name *tenax.* In the introduction Carpenter discussed in great detail the centrodorsal, radial pentagon and associated structures, as well as the arm structure. He said that there is a closely allied, if not identical, species from Cebu (Zebu) in the museums at Dresden and at Vienna.

Under *Actinometra paucicirra* (=*Comatula rotalaria*) in the *Challenger* report Carpenter mentions a new species from the Mergui Archipelago which presents the same arrangement of the arm divisions as is found in *paucicirra*, but which differs from that species in having normally 2, and sometimes 3, postradial axillaries, and also in the presence of some 30 cirri on the centrodorsal.

In the same year (1888) Bell listed *Actinometra notata* as having been collected by Dr. John Anderson in the Mergui Archipelago. This name and record had been furnished him by Carpenter, and the species referred to was that briefly mentioned as a new form in the *Challenger* report

This new species, *Actinometra notata*, was described and figured by Carpenter in 1889; but he compared it only with *paucicirra* (*rotalaria*) and entirely overlooked its affinities with *stelligera.*

In 1890 Professor MacMunn described the coloring matter found in this species.

In 1891 Hartlaub recorded 3 specimens of *stelligera* from Samoa and Fiji in the Hamburg Museum, and one from Ovalau in the Lübeck Museum, giving the chief characters of the last.

In 1894 Professor Bell described from the Macclesfield Bank and figured a new species of *Antedon* which he placed in Carpenter's "*Spinifera* group" and called *Antedon bassett-smithi.* He also recorded this species from the same region under the names *Actinometra simplex* and *Actinometra maculata.*

In 1895 Professor Koehler discussed this species and mentioned that it is the same as Lütken's *tenax.* He also erroneously quoted Carpenter as saying that *nigra* is also a synonym of *stelligera.* He recorded a specimen from the Bay of Amboina, which, however, is more properly referable to *nigra.*

Chadwick in 1904 recorded a specimen of *Actinometra notata* from Ceylon.

In 1905 Minckert discussed in detail the articulations of and regeneration in this species.

In my first revision of the comatulids published in 1907 I had considerable trouble in placing Bell's *Antedon bassett-smithi.* It obviously did not belong in the *Spinifera* group in which it was described. As its reference to that group implied the occurrence of well developed side and covering plates along the pinnule ambulacra, it seemed to me most probable that it belonged to the group which I had very recently designated as the *Multicolor* group; that is, to the multibrachiate species related to *Neometra multicolor,* now included in the family Calometridae. Accordingly I assigned it to this group under the name of *Calometra bassett-smithi.*

In the year following, however, I discovered that it could not belong here, and decided that it was in reality a species of the *Palmata* group, which I assumed was "obvious from the shape of the lower pinnules as given in the plate." At the same time I called attention to the fact that the original description does not agree with the figure in respect to the number of the arms or of the cirri or the length of the first pinnule.

In his original description of *Antedon bassett-smithi,* Professor Bell had remarked on the "extraordinary divergencies exhibited by the syzygies of this species," and added that this form "will severely shake our faith in the value of the site of the syzygy as an aid in specific diagnosis." In 1909 I found that, had Bell referred the species to the *Stelligera* group of *Actinometra* instead of to the *Spinifera* group of *Antedon,* he would have seen that the arrangement of the syzygies was quite normal, and further that the specimen described under the name of *Antedon bassett-smithi* was none other than an example of *Comatella stelligera.* This was reasserted in 1912 and was confirmed by an examination of the type specimen in the British Museum in 1910, as recorded in 1913.

In a detailed study of the various species assigned to the genus *Actinometra* it was found that Carpenter's *Actinometra notata,* originally described in the *Paucicirra* group, was in reality a synonym of his previously described *Actinometra stelligera,* the type of the *Stelligera* group. This discovery was made possible through the study of the comatulids contained in the Copenhagen Museum, which included the first specimens of this species which I had been able to examine, and it was announced, together with the fact that *Antedon bassett-smithi* is also a synonym of this species, in the account of this collection published in 1909.

In my account of the recent crinoids of Australia published in 1911 I recorded a specimen of this species in the Australian Museum at Sydney which was labeled

"Port Jackson," and gave its essential characters. For the reasons given above (p. 108) I do not now believe that this specimen really came from Port Jackson.

In 1912 in an account of the comatulids in the Hamburg Museum I mentioned the two examples of this species from Samoa and Fiji. These were two of the three previously (1891) noticed by Hartlaub. Presumably the third had been sent to the Göttingen Museum. I also gave the chief characters of another specimen which bore a label in Chinese characters reading simply "very deep water." This may or may not have come from somewhere on the coast of China.

In my memoir on the crinoids of the Indian Ocean (1912) *Actinometra notata* and *Antedon bassett-smithi* were included in the synonymy of this species, as was also the *Actinometra maculata* recorded from the Macclesfield Bank by Bell in 1894. Previously unrecorded specimens from Padaw in the Mergui archipelago and from ?India were listed and their characters given.

In an account of the comatulids in the Berlin Museum published in 1912 this species was recorded from New Guinea, and the characters of the single specimen were given.

In the memoirs on the recent crinoids of Australia (1911) and on the crinoids of the Indian Ocean (1912) there were incorporated synonymical notes which I had made as a result of an examination of the collection of the British Museum in 1910. In 1913 I published a detailed account of this collection. *Antedon bassett-smithi* was proved to be a synonym of *Actinometra stelligera*, and the specimens which Professor Bell had recorded from the Macclesfield Bank under the names *Actinometra maculata* and *Actinometra simplex* were also found to belong to this species. The eight lots of specimens examined were listed, and the chief characters of the more interesting specimens were given.

In 1913 Dr. August Reichensperger recorded a specimen which has been collected by Doctor Sarasin in Ceylon in 1886 and noted its essential characters.

In 1915 Dr. Hubert Lyman Clark, who had visited Mer in September and October, 1913, when he was a member of the Carnegie expedition to that region, recorded this species as very common there, and published various notes on its color in life, its habits, and its reactions.

In 1918 I recorded it from four localities in which it had been found by the *Siboga* expedition and published a colored figure drawn from a specimen of which a detailed color sketch of one arm had been made immediately after capture.

Dr. Hubert Lyman Clark in 1921 published a detailed account of this species, especially as it occurs on the Australian coasts, based upon his experiences with it at Mer and accompanied by a colored figure.

It was in this account of the species that doubt was first expressed concerning the occurrence of this species at Port Jackson, New South Wales, whence I had recorded it 10 years previously.

Dr. Torsten Gislén in 1922, in his account of the crinoids collected by Dr. Sixten Bock in 1914, recorded this form from three stations in the Bonin Islands, and gave elaborate notes on the specimens.

Dr. Hubert Lyman Clark listed a specimen from Wooded Isle in the Abrolhos Islands (Houtman's rocks), Western Australia, in 1923, and gave its essential characters. In 1926 he recorded two specimens which had been collected by Mr. W. E. J. Paradice, the surgeon of the *Geranium*, a sloop of the Royal Australian Navy, which in 1924 was engaged in a detailed investigation of the Great Barrier reef on the Queensland coast.

COMATELLA MACULATA (P. H. Carpenter)

Plate 20, Figure 50

[See also vol. 1, pt. 1, fig. 146 (centrodorsal)., p. 220; fig. 449 (dorsal view of radial pentagon), p. 353; part 2, figs. 152, 153 (analysis of arm division), p. 83; pl. 1, figs. 953, 954 (centrodorsal and radials)]

Actinometra fusca Lütken, Mus. Godeffroy Cat., vol. 5, 1877, p. 100 (Port Denison; *nomen nudum*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 306, 307 (Bowen; *nomen nudum*).—A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (=*maculata*).

Actinometra maculata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 307 (description; Station 186; possibly identical with *fusca* from Bowen); pl. 5, figs. 1 *a–d*; pl. 55, fig. 2.—Hartlaub, Nova Acta Acad. German, vol. 58, No. 1, 1891, p. 105 (Mortlock I.; characters); p. 113 (in Göttingen Mus.).—Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 225 (west reef of Hulule; very commonly seen at shallow depths on lagoon reefs in all the more open atolls of the Maldives).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 716 (identity of Carpenter's records); Crinoids of the Indian Ocean, 1912, p. 35 (of P. H. Carpenter, 1888=*maculata*); p. 37 (of Hartlaub, 1891=*maculata*); p. 38 (of Bell, 1894=*stelligera*); p. 40 (of Bell, 1902=*Stephanometra indica*, in part); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 76 (of Bell, 1894=*stelligera*; of Bell, 1902=*maculata*+*Stephanometra indica*).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 5 (identity).

Actinometra pulchella Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 105 (Ruk, Carolines; description of the specimen).

Actinometra, sp. Bell, Proc. Zool. Soc. London, 1898, p. 849 (Rotuma).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 288 (of Bell, 1898=*C. maculata;* Rotuma; Bell's account quoted); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 3 (identity of Bell's record; outer part of reef at Rotuma).

Comaster maculata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia maculata A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comatella maculata A. H. Clark, Smiths. Miscell. Coll., vol. 52, part 2, 1908, p. 207 (structure); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 138 (synonymy; includes *fusca;* Bowen; description of a specimen; the cirri have a transition segment); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (*Actinometra multiradiata* recorded by Bell from southeast Africa is this species); p. 8 (southeast coast of Africa); p. 13 (common to southeast Africa and the Bay of Bengal, but not occurring in the Arabian Sea); p. 16 (references to African specimens; Salomon; Coin Peros; descriptions of specimens); Notes from the Leyden Mus., vol. 33, 1911, p. 177 (west Java); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 246 (New Caledonia; description); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (East Indian species occurring south to Bowen); p. 443 (range on east coast); Memoirs Australian Mus., vol 4, 1911, p. 717 (known to P. H. Carpenter from Australia); p. 721 (occurs south to Bowen); p. 732 (in key); p. 739 (annotated synonymy; characters; Australian record; range); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 4 (Ruk, Carolines; description; previously recorded by Hartlaub as *pulchella*); Crinoids of the Indian Ocean, 1912, p. 35 (=P. H. Carpenter's East Indian specimen of *pulchella* [in reality this is *difficilis*]; =*maculata* of Carpenter, 1888); p. 37 (=*maculata* and *pulchella* of Hartlaub, 1891); p. 38 (=*simplex* of Bell, 1894 [in reality this is *stelligera*]); p. 41 (=*multiradiata* Bell, 1909); p. 70 (synonymy; summary of previous records); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 3 (published references to specimens in the

B. M.; *Challenger* Sta. 186; west reef, Hulule, Male, Maldives; outer part of reef at Rotuma; Salomon, reef; characters of the specimens).—REICHENSPERGER, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 83 (Ceylon); p. 84 (Ceylon; Doctor Sarasin; characters of the specimen).—A. H. CLARK, Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of the distribution in Australia).—H. L. CLARK, Carnegie Institution of Washington Publication 212, 1915, p. 101 (common at Mer); pp. 107 and following (habits and reactions).—A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4 (in key; range); p. 7 (synonymy; detailed account; Stas. 89, 96, 213); pp. 272, 274 (listed).—H. L. CLARK, The Echinoderm Fauna of Torres Strait, 1921, p. 5 (history); p. 8 (collected by the Carnegie Exped., 1913); p. 12 (Mer; notes; habits and reactions; color); pp. 192 and following (range); pl. 3, fig. 1 (colored).—GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 16 (Bock's stations 53, 59; notes); figs. 4–6, p. 28.

Actinometra multiradiata BELL, Trans. Linn. Soc. (Zool.), ser. 2, vol. 13, pt. 1, 1909, p. 20 (Salomon; Coin Peros).

Diagnostic features.—The size is rather small; the cirri are small and weak, composed of 16–20 segments and 10 mm. in length; there are 19–20 arms which are between 70 and 80 mm. long; IIIBr series are not developed.

Description.—The centrodorsal is discoidal, with a broad flat polar area from 3 to 4 mm. in diameter. The cirrus sockets are arranged in from 2 to 3 closely crowded alternating marginal rows.

The cirri are XVIII–XXXV, 16–20, relatively small and weak, 10 mm. in length. The first segment is short, the second is about as long as broad, the fourth is half again as long as broad, the fifth and sixth are twice as long as broad, and the seventh is a transition segment, half again as long as broad, with the greater part of the surface dull like that of the preceding segments, but the distal portion highly polished like that of the succeeding segments. The following segments decrease in length, being terminally about twice as broad as long. The transition and following segments have a small distal dorsal tubercle which gradually moves nearer the center of the dorsal side and becomes more prominent, on the last 3 segments being median in position. The opposing spine is represented by a small centrally situated sharp tubercle. The terminal claw is longer than the penultimate segment and is stout and strongly curved. When compared with those of *C. stelligera* or of *C. decora* the cirri seem disproportionately slender and weak.

The ends of the basal rays are visible as small tubercles in the angles of the calyx.

The radials are just visible in the interradial angles over the ends of the basal rays. The IBr_1 are very short, oblong, not quite meeting basally. The IBr_2 are broadly pentagonal, about twice as broad as long. The IIBr series are 2; the $IIBr_1$ are united interiorly for rather more than the proximal half. IIIBr series are not developed. The division series are widely separated, exposing a strip of perisome equal in width to one-third or one-half the width of the IIBr series.

Arms 19–20, from 70 to 80 mm. long. The first 2 brachials are similar in shape and size, wedge-shaped, longer exteriorly than interiorly, and about twice as broad as the exterior length. The following 4 brachials are oblong, about twice as broad as long or slightly broader, those succeeding becoming triangular, about half again as broad as long, then gradually changing to wedge-shaped, twice as broad as long, and becoming slightly longer in the extreme distal portion of the arms. The brachials following the first few oblong ones have rather prominent distal ends thickly set with very fine spines, and a longitudinally striate dorsal surface.

The first syzygy is between brachials 1+2, except on arms springing directly from a IBr axillary, where it is between brachials 3+4. If the first syzygy is between brachials 1+2, brachials 3+4 may also be syzygially united The next syzygy is somewhere between brachials 11+12 to 15+16, usually about brachials 13+14. The distal intersyzygial interval is usually 3, sometimes 4, muscular articulations.

P_1 is slender, from 15 to 17 mm. in length, composed of 50 segments which are about as long as broad; the terminal comb has 15–17 narrow, triangular, slightly recurved teeth which reach a height of from one-half to almost the whole width of the segments. P_2 is similar, about 12 mm. long. P_3 is similar, about 9 mm. long. P_4 is similar to P_3 and only slightly shorter. P_5 and the following pinnules are without combs, slightly stouter than those preceding and much less flagellate, about 6 mm. long. The 2 basal segments of the first 4 pinnules on each side of the arm are more or less carinate. The distal pinnules are 7 mm. long.

The mouth is radial. The disk is naked, 12 mm. in diameter.

The color in alcohol is uniform dark reddish brown, or dark reddish brown mottled with patches of yellowish green.

Notes.—The description of this species as given covers both the type specimen from *Challenger* station 186 in the British Museum and the specimen from Bowen in the Copenhagen Museum. The two are almost identical. That from Bowen has 19 arms 80 mm. long, while the type has 20 arms 70 mm. long; the cirri in the specimen from Bowen are XVIII, 16–17, and in the type are somewhat larger, XXV–XXXV, about 20.

The specimen from Salomon has 26 arms 85 mm. long; the cirri are XXI, 15–18 (usually 17 or 18). When compared directly with the type specimen this is found to differ only in having a greater number of arms. All of the IIIBr series are developed externally.

The example from Hulule has 17 arms.

The specimen from Ceylon has 26 arms, most of which are in process of regeneration. According to Reichensperger the details agree well with those of the specimen from Bowen. The centrodorsal is of medium size, discoidal, and somewhat prominent. The cirri are XVII, 15–18; the middle segments are much longer than broad. The surface of the first 7–9 segments is rough and dull, but the segments following have a porcelainlike polished surface, which usually begins in the middle of one of the segments (the transition segment). The arm length scarcely exceeds 75 mm. The first 2 brachials are always united by syzygy. The 2 basal segments of the first 3 or 4 pinnules, especially on the outer side of the arms, are sharply carinate. P_2 is usually the stoutest pinnule.

The specimen from *Siboga* Station 96 is quite typical. There are 16 arms, and in addition a IIBr series ending in a pair of pinnules. The arms are 65 mm. long. The centrodorsal is thin discoidal with the dorsal pole flat, 3 mm. in diameter. The cirri are slender, XXI, 17–18, from 9 to 11 mm. long; the seventh, or more rarely the eighth, is a transition segment.

Doctor Mortensen's specimen from off Jolo had apparently 20 arms; the longest cirri have 18–19 segments.

The larger specimen from *Siboga* Station 89 has 22 arms 80 mm. long; the smaller, which is undergoing adolescent autotomy, has 21 arms.

The example from *Siboga* Station 213 is typical, with 20 arms 90 mm. long.

The specimen from New Caledonia has 19 arms; the cirri are XIX, 17–18.

The specimen recorded by Hartlaub (as *pulchella*) from Ruk, which I examined at Hamburg, has 20 arms; the cirri are XXIII, 15–17. As described by Hartlaub the centrodorsal is flat and thick discoidal with a circular circumference. The cirri are arranged in 2 irregular rows, and in part are not entirely confined to the margin. The fourth, fifth, and sixth cirrus segments are elongated. The segments in the distal half of the cirri are shorter, moderately high, and bear small dorsal spines. The opposing spine is not distinguished from the others by greater stoutness. The radials are partially visible. The IBr_1 are short and are free laterally. The IBr_2 (axillaries) are triangular with a sharp distal angle. The IIBr series are 2, and the $IIBr_1$ are only slightly united.

The 2 first brachials are very short, and are united by syzygy; the first are only for a short distance in contact with their fellows. The succeeding 3 or 4 brachials are irregularly discoidal and show a tendency to develop articular tubercles on the articulations. Toward the ends of the arms the segments become almost oblong. The first syzygy is between brachials 1+2, the second from between brachials 12+13 to between brachials 14+15, and those succeeding occur at intervals of usually 4 muscular articulations. P_1 is up to 10 mm. in length, slender and delicate, with a prominently marked comb. P_2 is markedly shorter, and the pinnules following gradually decrease in length to those of the eighth, tenth, and twelfth brachials, which are approximately of the same size, then increase, reaching a length of about 6 mm. On some arms the seventh brachial bears a very small pinnule. Combs occur as far as the pinnule of the tenth brachial. The disk is naked, 7 mm. in diameter; the mouth is radial.

The specimen from Bock's Station 53 which was identified as this species by Gislén has 10 arms 40+ mm. long. The cirri are XXIII, the peripheral with 17–18, the dorsal with 15–16 segments; the length of the cirri is from 7 to 9 mm. The fourth and fifth cirrus segments are the longest, twice as long as broad. From the fifth onward a dorsal transverse ridge is developed. The IBr_2 (axillaries) are twice as broad as long. The first brachials are free interiorly. The intersyzygial interval is 5 or 6 muscular articulations. The first 4 pinnules bear combs. P_1 is 5 mm. long with 30 segments of which 18 bear teeth; P_2 is a little shorter, and about 13 of its segments carry teeth; P_3 and P_4 have still shorter combs; P_5 is 3 mm. long with 11 segments. The distal pinnules are 5 mm. long with 13 segments. The disk is 5 mm. in diameter; the mouth is subcentral. The arm bases are tolerably smooth, and the synarthrial tubercles are obsolete. The arms are rather stout. The distal brachials are slightly overlapping with spinous, but not everted, distal ends.

One of the specimens from Bock's Station 59 has the centrodorsal 3.5 mm. in diameter and the bare dorsal pole 2.5 mm. across. The cirri are XXI, 19, from 10 to 12 mm. in length. The first and second segments are short, the third is about as long as broad and slightly constricted centrally, the fourth is a little longer, and the fifth-seventh are the longest, half again as long as broad. The following shorter segments bear dorsal spines. The penultimate segment is as long as broad. The terminal claw is stout and half again as long as the penultimate segment. A young cirrus has the fourth-seventh segments somewhat longer, twice as long as broad. The IBr_1 are five times as broad as long, free laterally. The IBr_2 (axillaries) are three times as broad as long, with the distal edges slightly everted. There is a slight synarthrial tubercle on the articulation between the elements of the IBr series. There are 15 (perhaps 16) arms 65 mm. in length. The IIBr axillaries are interiorly united for most of their length. Syzygies occur between brachials 1+2, 3+4, 14+15, 23+24, or 13+14 and 18+19, and distally at intervals of 5 or 6 muscular articulations. The proximal portion of the arms is not quite smooth. The first 8 brachials are discoidal, those following becoming wedge-shaped. The distal brachials are tolerably short with spinous distal edges which sometimes are everted and stand out like a collar.

The first 6 pinnules bear combs. P_1 is 9 mm. long with 36–38 segments, of which 18 bear teeth; the teeth are rather short, reaching a length of from one-half to one-third the width of the segments. P_2 is 6.5 mm. long with about 30 segments, of which 15–17 bear teeth. The following 3 pinnules decrease in length. P_6 is 4.5 mm. long with 22 segments, of which 12 bear teeth. The distal pinnules are from 5 to 6 mm. long with 17–18 segments. The disk is 8 mm. in diameter. The mouth and anus are subcentral. The anal funnel is 1.5 mm. high.

In the other specimen from station 59 the centrodorsal is pentagonal in outline, 3 mm. in diameter with the bare dorsal pole 2 mm. across. The cirri are XXV, 15–19, 9 to 11 mm. in length. The fourth and fifth segments are the longest, three-quarters again as long as broad; the sixth is a transition segment. The arms are 13 in number, 55 mm. long. The intersyzygial interval is from 4 to 6 muscular articulations. P_1 is 9 mm. long with 38 segments, of which 19–22 bear teeth. P_4 is 7.5 mm. long with 30 segments, of which about 18 bear teeth. P_5 is 4.5 mm. long with 17 segments, and P_6 is 4 mm. long with 15 segments, without a comb, but with dorsal hooks and, as in the preceding pinnules, with small spiny knobs on the outer side of the proximal segments. The distal pinnules are 6 mm. long with 19 segments, somewhat longer than broad, with spiny borders, and the last 6 with dorsal hooks. The disk is 6.5 mm. in diameter.

Abnormalities.—In the specimen from *Siboga* station 96, one of IIBr axillaries bears a pair of pinnules instead of the usual 2 arms.

Localities.—Salomon, from reef; *Sea Lark*, June 8, 1905 [Bell, 1909; A. H Clark, 1911] (1, B. M.).

Coin Peros [Bell, 1909; A. H. Clark, 1911].

Hulule, Maldives; west reef [Bell, 1902; A. H. Clark, 1913] (1, B. M.).

Ceylon; Doctor Sarasin, 1886 [Reichensperger, 1913].

West Java; J. F. van Bemmelen, 1894 [A. H. Clark, 1911] (1, L. M.).

Siboga station 96; Sulu (Jolo) archipelago, Philippines; southeastern side of the pearl bank; 15 meters; lithothamnion bottom; June 27, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 390).

Dr. Th. Mortensen's Pacific Expedition 1914–16; off Jolo (Sulu); coral reef; March 17, 1914 (1).

Siboga station 89; Pulu Kaniungan ketjil; 11 meters; coral bottom; June 21, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 213; Saleyer, south of Celebes; coral reef; October 26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger station 186; Prince of Wales Channel, Torres Strait (lat. 10° 30′ S., long. 142° 18′ E.); 15 meters; coral mud; September 8, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Mer, Murray Islands, Torres Strait; southeastern and southwestern reef flats; 1913 [H. L. Clark, 1915, 1921].

Mer, Murray Islands, east flat; September 25, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 554).

Mer; October, 1913 [H. L. Clark, 1915, 1921] (14, M. C. Z., 553).

Port Denison, Queensland [Lütken, 1877].

Bowen, Queensland [P. H. Carpenter, 1888; A. H. Clark, 1909, 1911] (1, C. M.).

New Caledonia [A. H. Clark, 1911] (1, P. M.).

Rotuma, outer part of the reef [Bell, 1898; A. H. Clark, 1912, 1913] (1, B. M.).

Ruk, Caroline Islands [Hartlaub, 1891; A. H. Clark, 1912] (1, H. M.).

Mortlock Island, Carolines [Hartlaub, 1891].

Dr. Sixten Bock's station 53; 2 miles east of Higashijima; 164 meters; sand and broken shells; October 7, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 59; eastnortheast of Anojima; 183 meters; October 15 1914 [Gislén, 1922].

Lot's Wife's Rock, north of the Bonin Islands, bearing NE. ¾ E., 1.1 miles distant; U. S. S. *Alert*, June 27, 1880 (2, U.S.N.M., 36172).

Japan (1). Pl. 20, fig. 50.

Geographical range.—From Salomon, Coin Peros, and the Maldive archipelago to Torres Straits, Bowen, Queensland, New Caledonia, Rotuma, the Caroline and Bonin Islands, and southern Japan.

Bathymetrical range.—From the shore line down to 15 meters, and undoubtedly deeper. Dr. Sixten Bock's records of 164–183 meters represent not the actual depth but the length of line out.

Remarks.—The record of this species from Coin Peros is based upon Bell's mention of "*Actinometra multiradiata*" from that locality. I have not seen his specimen. As the specimen recorded under this name from Salomon is this species, which is much more likely to occur at Coin Peros than *Capillaster multiradiata*, I am assuming that what he really had from Coin Peros was *Comatella maculata*.

History.—As in the case of the preceding species (*Comatella stelligera*), the first specimens of this form to reach Europe were brought home by the Godeffroy Co. to Hamburg, where they were labeled *Actinometra fusca* by Prof. C. F. Lütken and under that name distributed to various museums. *Actinometra fusca* was never described, but the name was listed in the catalogue of the Godeffroy Museum in 1877.

During a visit to the Copenhagen Museum Dr. P. H. Carpenter examined there a specimen of "*Actinometra fusca*" from Bowen. In the *Challenger* report (1888) immediately after the description of his new species *Actinometra maculata* he remarked that *maculata* was possibly indentical with Lütken's *fusca*, although (he said on the preceding page) he was not sure that the latter was not identical with [*Neocomatella*] *pulchella*.

Under the name of *Actinometra pulchella* Hartlaub in 1891 recorded a specimen of *maculata* from Ruk in the Carolines which he found in the Hamburg Museum, giving a detailed description of it; and under the name of *maculata* he recorded another in the Göttingen Museum from Mortlock Island in the same group.

Prof. F. Jeffrey Bell in 1898 recorded this species (as *Actinometra*, sp.) from Rotuma; in 1902 he listed it from the Maldive Islands, and in 1909 he noted it (as *Actinometra multiradiata*) from Salomon and Coin Peros.

In 1909 I published a detailed description of the specimen from Bowen labeled *Actinometra fusca* in the Copenhagen Museum, and definitely identified it with Carpenter's *Actinometra maculata*.

As a result of a visit to the British Museum in 1910 I found that Bell's *Actinometra multiradiata* from the southwestern Indian Ocean was in reality this species, a fact which I stated in a paper on the crinoids of the African coasts published in 1911. In my memoir on the crinoids of Australia published in the same year I gave the distribution of this species as corrected from my studies on the material in the British Museum and remarked that the type specimen in London resembled very closely the example from Bowen in the Copenhagen Museum. In the same year also I recorded it from western Java and from New Caledonia.

In 1912 I stated that Hartlaub's *Actinometra pulchella* from Ruk, which I had examined in the Hamburg Museum, represented the same species as Carpenter's *Actinometra maculata*.

In my memoir on the crinoids of the Indian Ocean (1912) I identified Carpenter's *Actinometra pulchella* from *Challenger* station 192 near the Ki Islands as *maculata*. It is, however, *Palaeocomatella difficilis*. Evidently I had at the time confused it with Hartlaub's *Actinometra pulchella* from Ruk. In the same memoir I identified Bell's *Actinometra simplex* from the Macclesfield Bank as *maculata;* it is in reality, however, *stelligera*.

In a paper on the comatulids in the British Museum published in 1913 Bell's *Actinometra simplex* and *A. maculata* from the Macclesfield Bank were placed in the synonymy of *stelligera*, where they belong.

The 4 specimens referable to *maculata* which I saw in this collection were Carpenter's type and 3 which had been recorded by Bell in 1898, 1902, and 1909 as given above.

Dr. August Reichensperger in 1913 recorded and described in detail a specimen from Ceylon. In 1915 Dr. Hubert Lyman Clark recorded this form as very common at Mer in Torres Straits, and gave a detailed account of its habits and reactions. (See vol. 1, pt. 2, pp. 602–604.)

In 1918 I recorded and described the specimens secured by the *Siboga* expedition, and in 1921 Dr. H. L. Clark published an exhaustive account of this species based primarily on his experience with it in Torres Straits, accompanied with a colored figure.

Dr. Torsten Gislén in 1922 described in detail certain specimens in Bock's collection from the Bonin Islands which he assigned to this form.

COMATELLA DECORA A. H. Clark

Comatula paucicirra A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 317 (Japan); Crinoids of the Indian Ocean, 1912, p. 71 (identity).

Comatella decora A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 71 (synonymy; detailed description; southern Japan; ?Ki Is. [latter is *Palaeocomatella difficilis*]); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4 (in key; range).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 15 (compared with *C. brachycirra*); Vidensk. Medd. fra Dansk naturh. Foren., vol. 83, 1927, p. 7 (Mortensen's Sta. 9; notes); figs. 1, 2, p. 15.

Diagnostic features.—The cirri are 15 mm. long and rather stout, but consist of only 12–13 segments, of which the fourth and fifth are rather over twice as long as broad; there are 19 arms about 90 mm. long; P_1–P_6 bear combs; P_1 is composed of about 40 segments and its comb has 12 teeth.

Description.—The centrodorsal is large, thick discoidal, with the large bare polar area flat, obscurely pitted about the periphery.

The cirri are XX, 12–13, 15 mm., long; the first segment is very short, the second is half again as long as broad, the third is twice as long as broad, the fourth and fifth are rather over twice as long as broad, the fifth is slightly longer than the fourth, and the sixth is about twice as long as broad; the following decrease gradually in length so that the last two or three before the penultimate are about as long as broad, and the penultimate is about half again as broad as long. From the sixth onward the distal dorsal edge of the segments is slightly everted, forming a low crescent-shaped or shallow V-shaped ridge across the distal end of the segment which appears as a low subterminal spine in lateral view. The dorsal surface of the seventh and following segments has a slight median carination. The opposing spine is triangular, blunt, arising from the entire surface of the penultimate segment, the apex subterminal to subcentral, low, equal to about one-third of the distal diameter of the penultimate segment in height. The terminal claw is twice as long as the penultimate segment, strongly curved basally but becoming straighter distally.

The ends of the basal rays are visible as rather large flattened rhombic tubercles in the angles of the calyx.

The radials are concealed in the median line, but interradially form a triangle over the ends of the basal rays; they are slightly separated distally. The IBr_1 are trapezoidal, short, over three times as broad as long, strongly rounded dorsally, separated basally by the distal divergence of the radials, the sides of adjacent IBr_1 diverging at a very obtuse angle. The IBr_2 (axillaries) are broadly pentagonal, about half again as broad as long, the lateral edges about as long as those of the IBr_1 with which they form an obtuse angle, the lateral edges of the IBr_2 on adjacent rays being practically parallel. A broad strip of perisome, in width about equal to one-third of the diameter of the IBr series, is visible between them (and similarly between the IIBr series), but it does not extend dorsally beyond their ventral edge. The IIBr series are 2 (8 are present and 2 absent in the type). The $IIBr_1$ are united for their proximal two-thirds, the distal third of the inner border of the two in each pair diverging in almost a straight line. The IIIBr are 2, only present in one instance, on the outer side of a derivative from a IBr series.

Arms 19 (in the type), about 90 mm. long. The first two brachials are similar, rather small, wedge-shaped, about twice as broad as long exteriorly, the first united interiorly in the proximal half, diverging widely in the distal. The third to the seventh or eighth brachials are oblong or slightly wedge-shaped, about twice as broad as long, the following becoming triangular, about as broad as long, and in the distal portion of the arm wedge-shaped again and longer than broad, reaching a length of about twice the breadth in the terminal portion.

The first syzygy is between brachials 1+2 except on arms arising direct from a IBr axillary and on the exterior arms of each ray where it is between brachials 3+4; on the interior arms a syzygy between brachials 1+2 is often immediately followed by another between brachials 3+4. The distal intersyzygial interval is from 3 to 5 muscular articulations.

P_1 is long and slender, slightly stouter basally than P_2, 15 mm. long, with about 40 segments, of which the first is very short, the next 8 or 10 are about as long as broad, the following are about half again as long as broad, and the distal are again about as long as broad. The terminal comb begins abruptly, and is composed of about 12 large, long, bluntly triangular teeth, which are rather strongly incurved, and about as long as the lateral diameter of the segments which bear them. The series of tooth-bearing segments maintains the same general direction as the segments preceding. P_2 is similar but shorter, about 11 mm. long. P_3 is similar but shorter, 8 mm. long with 26 segments; its comb is similar to that of P_1 and P_2. P_4 and P_5 are similar to P_3. P_6 is similar to P_5, with a similar comb, but stouter basally and bearing a small gonad on the third-fifth segments. The following pinnules are stouter throughout, but of the same length, composed of squarish segments, and without combs. The distal pinnules are slender, about 11 mm. long.

The mouth is central; the anal tube is small and inconspicuous, the anal area being no larger than the other interambulacral areas. Two of the ambulacral grooves divide at the mouth, as in *Thaumatocrinus*, but in one of these the two branches join again just before branching to the arms, forming a sort of perisomic island.

Notes.—As described by Gislén, the specimen from Mortensen's station 9 has the centrodorsal flattened, 3.8 mm. in diameter, with the cirri arranged in 2 rows.

The cirri are XXXVI, 13–15, from 14 to 17 mm. in length. The longest cirrus segment, which is the fifth or sixth, is three times as long as broad. From the eighth onward a dorsal spine is developed.

The 19 arms are 105 mm. long. Of the IIBr series, 7 are 2 and 1 is 4 (3+4). There is a single IIIBr 2 series. On the two arms following the IIBr 4 (3+4) series there is a pinnule on the first brachial and a syzygy between brachials 2+3 as in *Capillaster.*

Gislén gives an example of the usual arm structure. In this the IBr 2 series bears 2 IIBr 2 series. In the 2 arms borne by the IIBr series to the left there are syzygies between brachials 1+2, 3+4, 15+16, and 19+20 or 20+21. On the inner arm borne by the IIBr series to the right there are syzygies between brachials 1+2, 13+14, and 17+18, while on the outer arm borne by the IIBr series to the right the only syzygies given are between brachials 14+15 and 19+20.

P_1 is 17 mm. in length and is composed of about 40 segments, of which the terminal 9 bear teeth. P_5 is 8 mm. long and bears a comb. P_6 is 9.5 mm. long with 23 segments and has no comb. The distal pinnules are 10.5 mm. long with 21 segments.

The disk is 7.5 mm. in diameter. The mouth is central. The anal tube is 2.5 mm. high.

Localities.—*Albatross* station 4893; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 29° E., 5.5 miles distant (lat. 32° 32′ 00″ N., long. 128° 32′ 50″ E.); 174–194 meters; bottom temperature 13.28° C.; gray sand, broken shells and pebbles; August 9, 1906 [A. H. Clark, 1908, 1912] (1, U.S.N.M., E. 1309).

Mortensen's station 9; southwestern Japan, off Kiu Shiu (lat. 32° 15′ N., long. 128° 12′ E.); 164 meters; hard bottom; May 15, 1914 [Gislén, 1927].

Remarks.—It is rather curious that in the case of this species I should have fallen into the same error that Carpenter did when he described his *Actinometra notata*. I first mentioned the type and only known specimen (though with no indication of the basis for the record) under the name of *Comatula paucicirra* in 1908.

This error was soon discovered, and the species was described in detail in 1912.

In 1927 Dr. Torsten Gislén recorded and gave notes upon a second specimen taken not far from the locality where the type had been dredged by the *Albatross*.

COMATELLA BRACHYCIRRA Gislén

Comatella brachycirra Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 13 (description; Bock's stations 53, 55, 56, 59); figs. 1–3, p. 28; pl. 1, fig. 1.

Diagnostic features.—The cirri are not more than 7 mm. long, and are composed of 9–12 (usually 10–11) segments, of which the longest are from three to three and one-half times as long as broad; there are 10–18 (usually 12–15) arms which are from 20 to 75 mm. (usually between 50 and 70 mm.) long; there are no combs beyond P_3; P_1 has 22–28 segments, of which 7–9 bear teeth.

Description.—The centrodorsal is flattened, from 1 to 2 mm. in diameter, with a small dorsal pole up to 1.5 mm. in diameter which is smooth and peripherally somewhat furrowed; the cirrus sockets are arranged in 1 or 2 marginal rows.

The cirri are XII–XXV (usually XVII or XVIII), 9–12 (usually 10 or 11), from 4 to 7 mm. (usually 5 to 6 mm.) in length. The first segment is somewhat broader than long, the second is twice as long as broad, somewhat constricted centrally, the third and fourth are from three to three and one-half times as long as broad, the last with the distal end in part everted, the fifth is twice as long as broad, and the sixth and following are about as long as broad with inconspicuous blunt dorsal spines which become sharper on the two outermost. The terminal claw is strongly curved and rapidly tapering, twice as long as the penultimate segment.

The ends of the basal rays are visible as rounded tubercles in the interradial angles.

The radials are almost concealed by the centrodorsal in the midradial line, or are visable as narrow bands. The IBr_1 are short, three times as broad as long, free laterally, and synarthrially united with the IBr_2. The IBr_2 (axillaries) are low pentagonal, half again as broad as long, with the distal edges slightly everted. The IIBr series are 2.

The arms are 10–18 (usually 12–15) in number, from 20 to 75 mm. (usually from 50 to 70 mm.) in length. The first brachials are interiorly in close contact, or free. The first 6 or 7 brachials are oblong and those following are wedge-shaped, the longest being as long as broad. The bases of the arms are remarkably smooth, and the distal brachials do not overlap.

Syzygies occur between brachials 1+2 on the inner arms from each IIBr series and 3+4 on the outer, then between brachials 12+13, 17+18, 21+22, and distally at intervals of 3 muscular articulations.

The first 3 pinnules bear combs. In one specimen P_4 occasionally bears a comb of 5 teeth; it consists of 17 segments. P_1 is from 5 to 7 mm. (usually 5 to 6 mm.) in length with 22–28 segments, of which the first 2 are short and the remainder are half again as long as broad; the distal 7–9 segments bear teeth. P_2 is from 3.2 to 5 mm. long with 17–22 segments, of which 5–7 (usually 6) bear teeth. P_3 is from 3 to 4 mm. long with 17–21 segments, of which 5–7 bear teeth. P_4 is from 3.5 to 4.5 mm. in length with 14–16 segments which are somewhat spinous; it bears no comb. P_5 is 4 mm. long with 15 segments. P_6 is 3.5 mm. long with 14 segments. The distal pinnules are from 5 to 7.5 mm. long with 15–20 (usually 17–18) segments, of which the first is short and those following are half again as long as broad; the distalmost bears small hooks

The disk is from 3.5 to 4 mm. in diameter, colored dark brown with calcareous concretions. The mouth is central. The anal tube is short, 1.2 mm. long.

Notes.—In one specimen from station 53 with 15 arms 20 mm. long and the disk 2.5 mm. in diameter P_2 is sometimes and P_3 is always absent.

Localities.—Dr. Sixten Bock's station 53; Bonin Islands, 2 miles east of Higashijima; 164 meters; sand and broken shells; August 7, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 55; Bonin Islands, eastnortheast of Chichijima; 210 meters; August 15, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 56; Bonin Islands, east of the channel; 210 meters; August 15, 1914 [Gislén, 1922] (1, U.S.N.M., E. 1109).

Dr. Sixten Bock's station 59; Bonin Islands, eastnortheast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922].

Geographical range.—This species is only known from the Bonin Islands.

Bathymetrical range.—From the records apparently 164–210 meters; but the depths as given represent the length of line out, not the actual depths.

Remarks.—This species is known only from the specimens collected by Dr. Sixten Bock in 1914 and described in detail by Dr. Torsten Gislén in 1922.

Genus NEOCOMATELLA A. H. Clark

Antedon (part) POURTALÈS, Bull. Mus. Comp. Zoöl., vol. 5, No. 9, 1878, p. 216, and following authors.

Actinometra (part) P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 158, and following authors.

Actynometra (part) FILHOL, La vie au fond des mers, 1885, p. 213.

Comaster (part) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Phanogenia (part) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124.

Comatella (part) A. H. CLARK, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, part 2, 1908, p. 207.

Neocomatella A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 177 (type *Antedon alata* Pourtalès, 1878); p. 176 (included in the Capillasterinae); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 9 (indicates a West Indian element in the northwest African fauna); p. 10 (represents in the Atlantic the eastern *Comatella*); Mem. Australian Mus., vol. 4, 1911, p. 738 (represents the East Indian *Comatella* in the Caribbean); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 389 (discussion of affinities and relations); p. 390 (very closely related to *Comatella* which it represents in the West Indies); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Comatella*); Internat. Revue der gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 3, et seq. (represents in the Atlantic *Comatella;* range and its significance); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (represents the Indo-Pacific *Comatella*, which occurs at Madagascar, in the middle Atlantic region); Die Crinoiden der Antarktis, 1915, p. 181 (range; corresponds to the eastern *Comatella*); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Expedition, 1918, p. 3 (in key); Univ. Iowa, Studies in Nat. Hist., vol. 6, No. 5, 1921, p. 12 (West Indian and east Atlantic); p. 14 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, p. 38 (range); p. 50 (in key).—GISLÉN, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 38 (brachial homologies).

Diagnosis.—A genus of Capillasterinae in which the arms are more than 10 in number; all of the division series are 2; the first pinnule is on the second brachial; the first syzygy on arms arising from a IIBr axillary is between brachials 1+2 and the second is between brachials 3+4, or on the inner arms commonly between brachials 4+5 or 5+6; the brachials beyond the basal are triangular, about as long as broad, and the centrodorsal is of moderate size or rather small, with the cirri arranged in very irregular rows.

Geographical range.—From St. Paul's rocks off the coast of Brazil northward throughout the Caribbean Sea to the Dry Tortugas and Bahamas; from the Canary Islands northward to Brittany.

Bathymetrical range.—From 13 to 1,710 meters.

Thermal range.—From 8.33° to 21.50° C.

Remarks.—The genus *Neocomatella* differs only slightly from *Comatella* in structure, though the general appearance of the individuals of the species of the two genera is quite different.

Neocomatella is a more generalized type than *Comatella* with fewer arms, more elongate brachials, and more slender cirri. In the small abyssal east Atlantic species the number of arms is rather constant—about 20—as in the case of the small species of *Comatella*, but in the large American species, which live in shallower water, the number of arms is very variable, ranging from 11 to 22 and averaging about 16. Some nearly full-grown individuals have only 10 arms. P_1 is the largest and longest pinnule, and, as in *Comatella*, it is of variable size. The following pinnules may decrease regularly in length, or P_2 may be abruptly smaller and shorter than P_1.

It is interesting to note that in a specimen of *Neocomatella pulchella* recorded herein one of the arms arising from a IIBr series has a pinnule on the first brachial and the first syzygy between brachials 2+3 as in *Capillaster* and *Nemaster*.

KEY TO THE SPECIES IN THE GENUS NEOCOMATELLA

a^1. Cirri stout with 15–21 (usually 18–19) segments of which the longest proximal are about twice as long as broad (Caribbean Sea to St. Paul's rocks; 13–567 m.).

b^1. No modification of the distal borders of the brachials (Caribbean Sea to St. Paul's rocks; 13–567 m.) ---------- **pulchella**, p. 124.

b^2. Distal edges of the brachials strongly produced and everted, standing out nearly at right angles to the axis of the arm (Bahamas to Barbados and Grenada; 122–493 meters) **alata**, p. 142.

a^2. Cirri more slender with 14–15 segments, of which the longest proximal are 4 times as long as broad, or even rather longer (Brittany to the Canary Is.; 400–1,710 meters) - **europaea**, p. 150.

NEOCOMATELLA PULCHELLA (Pourtalès)

Plate 5, Figures 10–12; Plate 6, Figures 13–16; Plate 7, Figure 21; Plate 23, Figure 64

[See also vol. 1, pt. 1, fig. 233 (ventral view of centrodorsal), p. 247; fig. 416 (basal ray) and fig. 427 (radial), p. 321; fig. 450 (dorsal view of radial pentagon), p. 353; pt. 2, figs. 3, 4 (centrodorsal and radials), p. 6; fig. 186 (lateral view), p. 104; figs. 372, 373 (pinnule tip), p. 243; figs. 600–602 (comb), p. 309; fig. 782 (adambulacral deposits), p. 366; pl. 1, fig. 955 (radial articular faces)]

Antedon meridionalis (part) Pourtalès, Bull. Mus. Comp. Zoöl., vol. 5, No. 9, 1878, p. 214 (23° 32′ N., 88° 05′ W.).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 442 (bottom of page), 443 (correction of Pourtalès).

Antedon pulchella Pourtalès, Bull. Mus. Comp. Zoöl., vol. 5, No. 9, 1878, p. 216 ([West Indies]; description).—P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 159 (united with *Antedon alata* under the name *Actinometra pulchella*).—Perrier, Nouv. archives du mus. d'hist. nat., Paris, sér. 2, vol. 9, 1886, p. 152 (anatomy; after Carpenter).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 490 (status of the name); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 6 (history).

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p. 51 (comparison with *Uintacrinus*), p. 88 (range).—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. CLARK, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (of Carpenter, 1888, includes *Palaeocomatella difficilis*, *Neocomatella europaea*, and *N. atlantica*).—HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 281, 413 (=*echinoptera*); p. 419 (variety of *echinoptera*); p. 421 *Blake* stations 193, 201, 224, 269, 294; myzostomes).

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Actinometra echinoptera var. *meridionalis-pulchella* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 417 (*Blake* station 287); p. 418 (Barbados, 7½–50 fathoms); p. 462 (description); pl. 18, fig. 3.

Actinometra echinoptera var. *pulchella* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 419 (discussion); p. 423 (stations 32, 45); pp. 438–462 (detailed account; Barbados, *Hassler*, 100 fathoms; *Blake* stations 249, 259, 241, 277, 273, 290, 296, 298, 294, 299, 287, 232, 231, 224, 269, 219, 216; off St. Lucia, 13° 52′ N., 61° 07′ W., Capt. Cole; *Blake* stations 206, 210, 189, 156, 157, 158, 139, 134, 152, 148; 23° 32′ N., 88° 05′ W.; 25° 33′ N., 84° 21′ W.; between Martinique and Dominica, 160–380 fathoms; La Chorrera, Cuba, *Corwin*; ?locality); p. 447, figs. 14, *a*, *b*; pl. 18.

Actinometra echinoptera var. *carinata-pulchella* (part) HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Blake* station 155).

Actinometra echinoptera var. *aplanata* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, p. 417 (no locality).

Actinometra echinoptera var. *pulchella* subvar. *planata* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 419 (discussion); p. 440 (*Blake* station 259); p. 442 (*Blake* station 206; 13° 52′ N., 61° 07′ W.; St. Lucia, Capt. Cole; *Blake* stations 210, 158, 134); p. 444 (?locality; characters); pl. 18, figs. 8, 11, 13.

Neocomatella atlantica A. H. CLARK, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 4 (reference to specimen in the British Museum; St. Paul's Rocks, 10–80 fathoms, *Challenger;* characters of the specimen).

Neocomatella pulchella A. H. CLARK, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, pp. 9–11 (occurrence at Barbados); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range).

Diagnostic features.—This species is readily distinguishable from *N. europaea* by its more robust cirri, which are composed of more numerous segments, the longest of which are only about twice as long as broad or very slightly longer; it is also much larger. The cirri are XV–XXX (but rarely more than XX), 15–21 (usually 18–19); the arms are 11–22 (usually about 15) in number, from 100 to 120 mm. in length.

This is the only comatulid in the western Atlantic with more than 10 arms, all the division series of 2 ossicles, the distal edges of the brachials not produced and everted, and a conspicuous comb on the outer portion of the proximal pinnules.

Description.—The centrodorsal is moderately large and thick, discoidal, with the bare polar area flat or slightly convex, usually about 3 mm. in diameter. The cirrus sockets are arranged in one and a more or less complete second crowded and irregular alternating rows.

The cirri are XV–XXX (rarely over XX), 15–19 (usually about 18), about 15 mm. long. The first 2 segments are very short, the third is about as long as broad or nearly so, and the fifth is the longest, twice as long as broad, and a transition segment. The sixth segment is rather more than half again as long as broad, and the eighth and following are about as long as broad or slightly broader than long. The fifth and following segments have the distal dorsal edge everted, forming a straight or slightly convex transverse ridge which appears as a blunt spine in lateral view. This ridge progressively becomes narrower, at the same time gaining in height, so that the last 6 or 8 segments are provided with a moderately high terminal dorsal spine which is rather blunt and arises gradually from the distal half of the dorsal surface of the segment. The opposing spine is low, blunt and inconspicuous, arising from the entire dorsal surface of the penultimate segment. The terminal claw is longer than the penultimate segment, moderately stout, rather slightly curved. The fourth-sixth segments are slightly constricted centrally and have somwehat enlarged ends.

The ends of the basal rays are visible as small tubercles in the interradial angles.

The radials are only visible as small triangles over the ends of the basal rays. The IBr_1 are very short, oblong, from four to six times as broad as long, or even broader. The IBr_2 (axillaries) are short and broad, almost or quite triangular, about twice as broad as long, or somewhat broader. The IBr_1 are almost or quite wholly united, but are usually separated distally by a narrow U-shaped gap. The IBr_2 are rounded laterally and usually well separated, rarely just in apposition. The IIBr series are 2, present on some, rarely on all, of the rays. The IIIBr series are 2, not usually present, and when found developed exteriorly in reference to the IBr series.

Arms 11–22 (usually about 15), from 100 to 120 mm. long. First 2 brachials short, small, approximately equal in size and similar in shape, slightly wedge-shaped, the first interiorly united. These are united by syzygy in arms arising from a IIBr axillary, and in the interior arms from a IIIBr axillary. The third and fourth brachials are similar to the first and second, but oblong, forming a syzygial pair which is about as long as broad or slightly broader than long. The fifth brachial is approximately oblong, about twice as broad as long, the sixth is wedge-shaped, and the seventh and following are triangular, not quite so long as broad, becoming shorter in the distal portion of the arm and in the terminal portion wedge-shaped and about twice as broad as long. The fourth and following brachials have somewhat prominent distal ends beset with fine spines. This prominence of the distal ends of the brachials usually increases to about the second syzygy, then remains about the same to the end of the arms. It is usually slight or moderate in amount; sometimes it is practically lacking, sometimes very pronounced.

In arms arising from IBr axillaries the first syzygy is between brachials 3+4; in arms arising from IIBr axillaries the first syzygy is between brachials 1+2, and the second on the outer arms is always between brachials 3+4, while on the inner arms it is usually between brachials 3+4, though sometimes between brachials 4+5 or 5+6; rarely this second syzygy is omitted on the inner arms.

P_1 is from 15 to 18 mm. long, and is composed of about 45 segments, of which the first 5 or 6 are about twice as broad as long, pointed dorsally, and the following become gradually less broad and about as long as broad after the tenth. The distal comb arises gradually; it is composed of 3 or 4 rudimentary and 16 well-developed teeth which are rounded triangular, higher than broad, slightly incurved, well separated basally, and about equal in height to the width of the segments which bear them. The more proximal teeth are separated basally by a space about equal to their own basal width, but this space decreases distally. P_2 is from 9 to 12 mm. long with about 40 segments, and resembles P_1 but is less stout basally. P_3 is from 8 to 9 mm. long with 32–35 segments, resembling P_2 but slightly more slender. P_4 is similar to P_3 and of about the same length. P_5 is 6 mm. long, slightly stouter than P_4, and more evenly tapering, with about 16 segments, of which the first is short and the following gradually increase in length, becoming about as broad as long after the seventh and about twice as long as broad terminally; this pinnule bears no comb. The following pinnules are similar but slowly increase in length, P_{11} and P_{15} being 9 mm. long. The distal pinnules are about 12 mm. long with 24 segments, of which the first 2 are very short, the fourth and fifth are about as long as broad, and those following gradually become elongated, being about twice as long as broad distally.

The pinnules in the proximal portion of the arm are more or less carinate dorsally, especially in the basal part; this character gradually becomes less and less marked, disappearing at the end of the proximal third or half of the arm.

The disk is naked, or more or less covered with large or small calcareous concretions. The anal tube is usually subcentral and the mouth submarginal; but either the anal tube or the mouth may be quite central in position.

The color in alcohol is white, straw colored, dark gray, or light or dark brown, either plain or more or less mixed with dirty lilac. Most of the specimens which I have examined are straw colored with a median dorsal line of light brown on the arms.

This description was drawn from typical specimens in the *Albatross* collection and does not take into account extreme and unusual features exhibited by a small minority of individuals. These are considered in the discussion following.

Notes.—Among the multibrachiate specimens which Hartlaub referred to this form he noted three marked varieties which he designated as *pulchella*, *alata*, and *planata*. He remarked that the last is so very different that he was long in doubt whether it ought not rather to be considered as a valid species; but he found in the collection a few intermediates between it and true *pulchella*.

The characters of the variety *planata* are found in the division series, which are broad and flattened, broadly in contact with their neighbors laterally, and broadly "wall-sided." Very young individuals sometimes exhibit not only these features, but in addition also have a very large number of arms. The extreme phase of this variety was found in a lot which unfortunately had no locality label. Except for the broadened division series they were extremely slender. Hartlaub gives the range of the variety *planata* as 240–560 meters.

There were 108 specimens in the material studied by Hartlaub, nearly all of which were from the *Blake* collection. Of these 14 were 10-armed and for the most part very young. He remarked that the varietal characters of the very young individuals are as a rule not pronounced so that the definite assignment of these to one or another of the varieties is not possible.

He mentions as of especial interest some medium-sized 10-armed specimens which by their dark brown color and in other ways recalled *meridionalis* though they do not belong to this form since certain *pulchella* characters are present, and at the same station multibrachiate individuals of *pulchella* were dredged.

The specimen from the Gulf of Mexico has 11 arms 50 mm. long.

Of the 4 specimens from *Blake* station 45Ag., 2 have 10 arms, 1 has 12, and 1 has 19. One of the 10-armed specimens has an arm length of about 100 mm. The 12-armed and the 19-armed specimens are both dark brown with individual arms lighter and the cirri white. The arms are smooth dorsally, and the IBr series are free and rounded laterally. The cirri have 3 short basal segments. The centrodorsal is large and discoidal.

Hartlaub described 4 rather large 10-armed specimens of *pulchella* in the restricted sense from *Blake* stations 45Ag. and 32Ag. which were referred by Pourtalès (1878) to *meridionalis* (=*Comactinia echinoptera*). All 4 of these are a uniform fairly dark brown with light or white cirri. One from *Blake* station 45Ag. has some of the arms lighter, though these are always dark at the base. One of those from *Blake* station 45Ag. is fairly well preserved. The tips of all the arms are broken off, but some are preserved for a length of 90 mm. The first brachials vary in the different specimens from almost complete interior contact to complete freedom. With the exception of the color and the number of arms these 4 specimens exhibit characters which agree with those given in Pourtalès original description.

Of the 5 specimens from *Blake* station 32Ag., 2 are of medium size with 10 arms and are brown and violet in color. In their color and in the characters of the centrodorsal they strongly recall *meridionalis* (=*Comactinia echinoptera*), under which name they were recorded by Pourtalès in 1878. Of the other 3 one has 11 arms, one 13, and one more than 13, although through breakage the exact number can not be determined. These are brown, usually with individual arms darker, and in 2 of them the centrodorsal is also dark. The cirri, however, are always light. In the 11-armed and in the 13-armed specimens a darker longitudinal stripe can clearly be seen. All of the specimens have smooth arms and laterally free and rounded IBr series. As is often the case in this species, small synarthrial tubercles are present.

Of the 3 specimens from *Albatross* station 2354, 2 have 22 arms and 1 has 19 arms.

The specimen from *Albatross* station 2353 has 20 arms.

The example from *Albatross* station 2154 has 17 arms.

The specimen from *Albatross* station 2169 has 13 arms.

Of the 4 specimens from *Albatross* station 2337, 2 have 12 arms, 1 has 13 arms, and 1 has 14 arms.

The specimen from *Albatross* station 2342 has 21 arms.

Of the 2 specimens from *Albatross* station 2345, 1 has 11 and one 19 arms.

The specimen from *Albatross* stations 2160–2162 is a large 11-armed example.

The example from *Albatross* station 2333 has 20 arms.

From *Albatross* station 2341 there is a small specimen with 10 arms.

Of the 2 specimens from *Albatross* station 2326, 1 is a 13-armed adult and the other is a 10-armed young with a central mouth.

Of the 2 specimens from *Albatross* station 2320, 3 have 12 and 1 has 18 arms.

One 13-armed and one 18-armed specimen are from *Albatross* station 2327.

The material from off La Chorrera, Cuba, consists of a very small 11-armed specimen and fragments of others, with IIBr series.

From *Blake* station 139 there is a large specimen with 19 arms.

Blake station 134 yielded one very fine specimen with between 16 and 20 arms; the division series are strongly "wall-sided."

From *Blake* station 152 there is a large example with 20 arms.

The 2 large specimens from *Blake* station 148 each have 20 arms, which in 1 are about 80 mm., in the other about 100 mm. in length. The division series and lower brachials in both of these are dark brown in color.

Of the specimens from *Blake* station 156, 1 has 14 arms about 80 mm. long, 1 is large with 19 arms, and 2 have 20 arms; another is medium sized. A young 10-armed specimen has an arm length of between 55 and 60 mm. The IBr_1 are entirely free laterally, and laterally rounded. The IBr_2 (axillaries) have a somewhat excavated surface. The brachials are smooth, rounded dorsally, and triangular. The third and fourth segments of the proximal pinnules have an unusually strong spinous production. This specimen, which was called *meridionalis-carinata* by Hartlaub, is the young of this species.

From *Blake* station 157 there are 2 specimens with 16–20 arms, and an 11-armed young with relatively slender arms. The color is white, with the syzygial pairs brownish. The IBr_1 are free laterally, and the arms are smooth dorsally. The centrodorsal is slightly convex. The IBr_2 (axillaries) are broader than the IBr_1.

Of the 5 specimens from *Blake* station 158, 3 have 20 arms and 2 have nearly 20 arms. All are large or medium sized. One of the 20-armed specimens is violet in color and has "wall-sided" division series.

Of the 4 specimens from *Blake* station 189, 1 has 19 arms, which were probably about 150 mm. long, and 3 are large with 16–20 arms and the division series laterally free.

Of the 4 specimens from between Dominica and Martinique in 292–695 meters, 2 have apparently 11 arms, 1 has 12 arms, and 1 has between 15 and 20 arms. In color they are all dark brown with lighter cirri. The arms in all are smooth dorsally. The centrodorsal of all is curious in being rather small, and not discoidal but more or less hemispherical. The cirri have 3 short basal segments. The IBr_1 are always free laterally. The elements of the IBr series have in part strongly produced ends and a sunken dorsal surface, and the same may be true of the lower brachials; this gives the profile of this portion of the animals a scalloped appearance.

The single small specimen from *Blake* station 206 has 13 arms and "wall-sided" division series.

The single specimen from *Blake* station 210 is of medium size with 18 arms; the division series are "wall-sided."

Of the 6 specimens brought up by the *Investigator* from 508 meters off St. Lucia 5 were examined by Hartlaub; these are of medium size with from 17 to 20 arms. One of them has the division series broadly "wall-sided."

The single example from *Blake* station 216 has 17 arms; the division series are broadly "wall-sided."

The single example from *Blake* station 219 which was examined by Hartlaub has 17 arms; the division series are laterally free with rounded sides. Two other specimens each have 20 arms.

The single rather small specimen from *Blake* station 287 has 11 arms, there being a single IIBr 2 series present. As shown in Hartlaub's photograph the outer arm arising from the IIBr axillary has the first syzygy between brachials 3+4, while the inner arm has syzygies between brachials 1+2 and 3+4. The cirri are slender, and according to Hartlaub resemble those of *Leptonemaster venustus*. The IBr_1 are laterally entirely free. The pinnules of the lower portion of the arms are composed of mostly cylindrical segments. The comb on the proximal pinnules is prominently developed. The centrodorsal is flat and sharply pentagonal. There are paired longitudinal dorsal stripes on the arms. Hartlaub called this specimen *meridionalis-pulchella*.

Of the 5 specimens from *Blake* station 296, 3 have from 11 to 15 arms and 2 have from 16 to 20 arms.

From *Blake* station 277 there are two 10-armed young, one 11-armed young, and one 13-armed specimen of medium size.

The 13-armed specimen is whitish with a fairly broad yellow longitudinal band on the arms and yellowish brown syzygial pairs. The IBr series are broad, and the IBr_1 are for the most part entirely in contact. The arms are smooth dorsally. The cirri have 3 short basal segments.

Four very young 10-armed specimens, 2 from *Blake* station 269 and 2 from *Blake* station 277, already show variations similar to those seen in the adults. In 3 of these the color is already the same as that seen in very many large specimens—white with brown bands on the arms and the centrodorsal and the parts immediately adjacent brown. One of the specimens from station 269 is uniformly white.

In spite of their small size the specimens have the IBr_1 very close together, and 1 from station 269, which has strong processes on the edges of the brachials, has the IBr_1 already in lateral contact.

In all the centrodorsal is gently convex. In the cirri only the first 2 segments are short, the third and those immediately following being elongate.

All the 4 specimens agree in having the arms narrow at the base and gradually broadening toward the middle.

Of the 3 specimens from *Blake* station 277 or 298, 1 has 15 arms about 65 mm. long, 1 has 18 and 1 has 19 arms.

From *Blake* station 298 there are 3 specimens, 1 with 20 arms about 75 mm. long, all the IIBr series being present; 1 with 15 arms, 3 on each of 3 rays, 4 on 1, and 2 on the fifth, about 60 mm. long (listed by Hartlaub as having 16–20 arms); and 1 with 9 arms and a IIBr axillary bearing 2 arms as yet very small (listed by Hartlaub as having 10 arms); this last is light brownish in color and has much elongated cirrus segments.

One of the specimens from *Blake* station 297 has 14 arms about 80 mm. long.

Of the specimens from *Blake* station 294, 1 has 20 arms and 1 has between 16 and 20 arms.

One of the specimens from *Blake* station 299 has 19 arms.

One of the specimens from *Blake* station 232 has 20 arms.

The 2 specimens from *Blake* station 231 included under M. C. Z., 481 have between 16 and 20 arms.

One of the specimens from *Blake* station 224 has 20 arms.

Of the specimens from *Blake* station 269, 2—one with 17 and 1 with 18 arms—are small and are remarkable for the breadth of the division series which are in close contact laterally and sharply "wall-sided." Of the other specimens, one has 10, one 14, and one 19 arms.

The specimen from *Blake* station 241 is large, with 20 arms.

Of the specimens from *Blake* station 259, 3 are of medium size, 1 is quite young with 12 arms, and 1 is small with the rays in close lateral contact and "wall-sided."

Of 3 specimens from *Blake* station 249 (M. C. Z., 27) which were not seen by Hartlaub, the largest has 15 arms, one IIBr series being developed on each ray, which are about 80 mm. long; the other 2 each have 20 arms which are about 50 mm. and about 65 mm. long. The individual designated as M. C. Z., 406, has 19 arms. Hartlaub noted that among the adult multibrachiate individuals from this station some have the IBr_1 in the closest lateral contact, while some have the IBr_1 laterallly free and with rounded sides. In many the lateral contact is not confined to the IBr_1, but extends to the IBr_2 (axillary), the IIBr series, and the first brachials, and in some of these is accompanied by a sharp flattening of the ossicles against each other. Hartlaub specifically mentions the occurrence of the variety *planata* at this station.

The specimens from "probably off Grenada" Hartlaub designates as variety *planata*.

The cotypes of *Antedon pulchella*, from the "West Indies," are two 20-armed specimens.

Four specimens without locality data Hartlaub regarded as especially characteristic of the variety *planata*, the characteristic features of which are the slenderness and breadth and sharp lateral flattening of the division series and arm bases.

The centrodorsal is flat and discoidal, with the cirri arranged in a single marginal row, XIX in the largest.

The cirri have only 2 short basal segments. The third–sixth segments are elongated, the fourth especially so. So far as may be judged from the cirri preserved they are rather short; they are composed of about 12 segments, of which the short segments in the distal half bear dorsal spines.

The radials are concealed. The IBr and IIBr series are flattened, and their component elements are very short. Because of the very close lateral contact of the division series made possible by their sharply flattened sides, and their flattened dorsal surface, the division series of the 5 almost horizontally extended rays taken together form an almost uniform disk. There are slight synarthrial tubercles.

The IBr_2 (axillaries) are very short and triangular. The apposed edges of the elements of the IBr series, and sometimes also of the elements of the IIBr series, are thickened.

The 2 best preserved specimens have each 16 arms, both having a single IBr series without any IIBr series following. The arms are very slender. On arms arising from IBr axillaries the 2 first brachials, through being flattened dorsally and having produced lateral borders, have the appearance of the elements of IIBr series. But on arms arising from IIBr axillaries the first 2 brachials are not broadened, although they are somewhat more flattened than the succeeding brachials. The 2 first syzygial pairs are about as long as broad; then follow 2 oblong brachials which are somewhat shorter than the syzygial pairs, then a wedge-shaped brachial, and then a series of triangular brachials of moderate length which on about the twenty-seventh pass over again into wedge-shaped brachials. The arms are almost entirely smooth, and are rounded dorsally.

In arms arising from IIBr axillary syzygies occur between brachials 1+2 and 3+4, then from between brachials 13+14 to between brachials 18+19 (most commonly from between brachials 13+14 to between brachials 15+16), and distally at intervals of 4 or 5, or 3 or 4, muscular articulations. The syzygy between brachials 3+4 may be absent.

On arms arising from a IBr axillary the first syzygy is between brachials 3+4.

The character of the pinnules agrees with that of the arms. They are slender, and the 2 basal segments are in no way remarkable for any broadening.

P_1 has about 40 segments which after the tenth become very slender; about 12 of the distal bear a prominent comb.

The character of the following pinnules on the same arm side remains the same as far as P_4, which is 5 mm. long with 23 segments, the last 12 with prominent teeth. P_4 becomes very slender and flagellate after the sixth segment.

From P_5 onward the flagellate character disappears, and the comb is lacking. P_5 and the 2 following pinnules are about 4 mm. long. In these the basal segment is smaller than the second. The distal decrease in the size of the segments in these pinnules is more gradual than is the case in the pinnules preceding. Spinous keels occur only on the third and fourth segments of the pinnules following P_3, and are not prominent.

The pinnules in the middle of the arm are about 5 mm. long, slender and flagellate, with 15 segments, of which those from the sixth onward are elongated.

The color of all the specimens is white.

The specimen examined from St. Paul's rocks is large and has 20 arms. The distal dorsal edges of the pinnule segments are very strongly everted and produced so that the dorsal profile of the pinnule is deeply serrate. The longest cirrus stump remaining is 12.5 mm. long and consists of 9 segments, of which the sixth is the longest and is slightly over twice as long as broad; the segments following are slightly shorter; the sixth and following segments have the distal dorsal edge slightly produced.

Doctor Hartlaub gave a composite description of the many armed specimens of this species which he examined, practically all of which were from the *Blake* collection.

He says that the centrodorsal varies in its form from a broad, thick, flat, sometimes sharply pentagonal disk with 2 marginal rows of cirrus sockets (specimens from

Blake stations 45Ag. and 208) to a smaller thinner disk with a single marginal row of cirrus sockets (type specimen of variety *planata;* no locality), and to a smaller somewhat convex plate entirely covered with cirri (between Dominica and Martinique, 292–695 meters). Generally speaking, its size is proportionate to the size and relative development of the individual, but there are exceptions—as, for instance, a specimen with 15 or more arms from *Blake* station 32Ag., in which the centrodorsal is quite disproportionately large. Many of the large centrodorsals are slightly concave in the center (*Blake* stations 208 and 249). Many more of the larger than of the smaller have the cirri in an almost everywhere single row. Hartlaub considers this the usual arrangement of the cirri. A regular single row (as in a specimen marked "Locality lost") is rare, there usually being a partially developed second row. The types of *pulchella* have a small centrodorsal, and in both the specimens the cirri are in 2 rows. In its form and in its variations the centrodorsal, according to Hartlaub, resembles that of *Comactinia echinoptera.*

The cirri are XII–XXXII, averaging XIX. The highest number, XXXII, is in a specimen from *Blake* station 45Ag.; 2 others have XXX and XXVIII, respectively. In 2 from *Blake* station 189 and 1 from station 156 there are XXVIII and XXVII.

Like the centrodorsal the cirri are variable, although they show a fair degree of uniformity, especially in the number and form of their component segments. The length and stoutness of the third segment is variable. In different cirri on the same individual it may be either long or short; the latter condition is by far the commonest. But in some specimens the third segment is almost as long as the fourth. Sometimes the fifth and sixth segments instead of the fourth and fifth are the longest, as in a 19-armed specimen from *Blake* station 249.

The usual number of cirrus segments is about 20. The largest number observed was 24 (*Blake* station 241), the lowest 12 (no locality; 14 arms) and 9 (10-armed specimen from *Blake* station 298).

The longest cirrus measured 28 mm. (*Blake* station 208), but, on the other hand, cirri with a length of about 12 mm. are not rare (*Blake* stations 155, 156 or 298, and 277). The longest cirri of the specimens from *Blake* stations 208 and 241 are markedly stout, while the short cirri of the specimen labeled "Locality lost" are slender. Some specimens from *Blake* station 269 have rather long slender cirri. Stout cirri are apparently much rarer.

Very characteristic of the cirri are the dorsal spines on the distal segments. While these may be only very poorly developed, they are never absent.

In the great majority of the specimens studied by Hartlaub the division series are free laterally, often from the IBr_1 outward, or at least from the IBr_2 (axillary) outward. This is true in the type specimens of *pulchella;* but other specimens in all other ways similar to these (for instance, those from *Blake* station 298) have the division series in lateral contact.

The lateral contact of the division series is most pronounced in a series of specimens which are distinguished by having the division series in very close lateral apposition with sharply flattened sides; in this feature, as well as in their very slender build, they vary quite widely from the types. These specimens, designated by

Hartlaub as variety *planata*, come from various localities between Santa Cruz and Grenada, and there are also some without locality data.

Intermediates occur between this variety and the typical form, as, for instance, a 19-armed specimen from *Blake* station 249 which is very similar to the variety *planata* but has the IBr series only partially "wall-sided" and the IIBr series almost free with rounded sides.

A further characteristic of the variety *planata*, according to Hartlaub, is that, in contrast to the usual condition, the IBr series often have an excavated surface whereby they appear somewhat wrinkled. But this feature also occurs in specimens with the IBr series entirely free laterally; for instance, it is fairly well marked in the types of *pulchella*.

The IBr series, as well as the IIBr series, are commonly gently convex dorsally and rise to a low synarthrial tubercle at the articulation.

In the great majority of specimens in which the point can be determined the radials are only partially visible. But in a 13-armed specimen from *Blake* station 277 the radials have the entire distal border free of the centrodorsal.

In their essential features the IIBr series resemble the IBr series. They are rarely in contact with their neighbors on the adjoining rays, but the two series on a single ray are often in close contact with each other; at least, close contact between the $IIBr_1$ on a single IBr axillary is the rule. But as an exception there is a 17-armed specimen from St. Lucia in which the $IIBr_1$ are wholly free interiorly.

In the variety *planata* many of the IIBr series with the sides closely appressed and flattened against their neighbors have a marked lateral thickening.

Entire absence of IIBr series is rare. Hartlaub observed in all only 13 such cases, including one specimen the specific identification of which is uncertain. Hartlaub was at first of the opinion that the majority of the 10-armed specimens were young, but he later came to the conclusion that this idea was not tenable, as among the 10-armed examples he found specimens of all sizes.

In 86 specimens with IIBr series in which the arm number can be made out, the average number of the arms is 16.5. Twenty-one have 20 arms, 10 have 19, and none over 20; not a single specimen possesses IIIBr series.

The form of the arms, which above all else determines the habitus of the individuals, is very variable and full of strong contrasts. Hartlaub remarks that greater contrasts than those between the arms of the variety *alata* and those of the variety *planata* with "wall-sided" division series are scarcely conceivable. In one direction we find arms which are narrow at the base and gradually broaden toward the middle and are composed of brachials which dorsally bear strong winglike processes, and in the other direction we find entirely smooth and uniformly slender arms. Between these two extremes there are all possible intermediates. There are also certain other features of the brachials which vary between two wide extremes.

Imbrication of the distal ends of the brachials is almost never, or only in rare cases, present, and when it occurs it is only slightly developed. Correlated with this is the usually smooth union of the ends of the brachials.

Among very many specimens Hartlaub found only a single one (from *Blake* station 158) in which there was a gradual, at first very slight, decrease in the width of the arms from the base outward. More frequently specimens are found in which all or some of the arms are uniform in width from the base to the middle, as in the types of *pulchella*.

The arms are best preserved in 2 large specimens from *Blake* station 189. They measure, so far as they are preserved, 100 mm. from the first brachial and the missing tip may be estimated to have measured 15 mm., so that the total length would have been 115 mm. In a specimen from Barbados (or Montserrat) the arms as far as preserved measure 95 mm. and consist of 119 brachials.

In arms arising from a IBr axillary the first two brachials are short and discoidal and are united by synarthry. Then follows the first syzygial pair, which is approximately square, then 3 somewhat shorter approximately oblong brachials; with the seventh, or at the latest with the ninth, the long series of triangular brachials begins which at about the fortieth passes over into short wedge-shaped brachials. The first 2 brachials contrast with those following by their greater breadth, especially if they lie by the side of a IIBr series on the same IBr axillary, in which case they tend to resemble the elements of the IIBr series. The length of the triangular brachials is relatively constant. In the variety *planata* the series is interrupted by wedge-shaped syzygial pairs. In the form of the brachials, as well as in the mode of union between them the triangular brachials of the *pulchella* and *planata* types are similar to those of *Leptonemaster venustus*.

The arms arising from a IIBr axillary differ from those arising from a IBr axillary in that the first 2 brachials, which are syzygially united, are not broadened.

Specimens with entirely smooth arms are rare. As a rule even in the relatively smooth-armed varieties of *pulchella* and *planata* there is a certain roughness resulting from a slight overlapping of the distal ends of the brachials.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4, or rarely between brachials 4+5, and the second is sometimes as early as between brachials 6+7, though as a rule from between brachials 12+13 to between brachials 22+23, most commonly from between brachials 12+13 to between brachials 16+17.

In arms arising from a IIBr axillary the first syzygy is between brachials 1+2 and the second usually between brachials 3+4, though sometimes between brachials 4+5 or 5+6. Occasionally it is omitted, so that the second syzygy occupies the position usually taken by the third. This is the case on several arms of a specimen from *Blake* station 158 and on 5 arms of a specimen from *Blake* station 148. Sometimes, as in another large specimen from *Blake* station 158, a syzygy between brachials 5+6 immediately follows one between brachials 3+4. The syzygy between brachials 1+2 is rarely absent, but this occurs on one arm of a specimen from *Blake* station 148.

The intervals between the following syzygies are very variable. The greatest constancy is found in the variety *planata*, where the intersyzygial interval is from 3 to 6 muscular articulations, usually 4 or 5. The conditions in typical *pulchella*, on the contrary, are very diverse. In the dark-brown specimens from *Blake* station 45Ag. the intersyzygial interval is not over 5 muscular articulations, most commonly 3 or 4. On other specimens the usual number is 5 or 6, while on still others it is 8–10, or even 8–13. The intersyzygial interval often decreases distally.

Hartlaub remarked that the character of the pinnules varies with that of the arms that bear them. The pinnules range from those with a number of broad segments bearing a high spinous carinate process, as in the variety *alata*, to those in which the segments are neither markedly broadened nor bear carinate processes.

A constant feature is a number of proximal pinnules which decrease in length and are slender and flagellate with a more or less extensive comb on their very slender and whiplike distal portion. They are composed of short segments which are in contact only at one point so that the profile of both edges, but especially the distal, is serrate. These pinnules vary rather considerably in their details. The decrease in length may be very gradual, or P_2 may be abruptly shorter than P_1. This last condition occurs in 2 specimens from *Blake* station 294, one referable to *pulchella*, the other to *alata*.

The length of these pinnules naturally is proportionate to the size of the animal, though it varies in individuals of approximately the same size. Thus P_1 in the 12-armed brown specimen from *Blake* station 45Ag. is quite 20 mm. long with about 50 segments, while the length of the same pinnule on an even larger specimen from *Blake* station 148 is only 17 mm., and the pinnule is composed of only about 40 segments.

The comb of P_1 has 15–20 teeth, of which the points may be sharp or blunted. Traces of a comb are sometimes to be made out as far as P_7, while on other specimens the combs do not extend beyond P_5. But the comb on P_5 may have as many as about 14 teeth without the following pinnules having the slightest suggestion of a comb.

In the variety *planata* P_5 is usually without a comb.

Hartlaub notes that the form of the pinnule segments recalls that seen in *Comactinia meridionalis*. In different specimens the lateral processes and the amount of the development of spines is variable. The brown 12-armed specimen from *Blake* station 45Ag. has the segments of the first 12 pinnules on each side of the arm, except for the first 2, with stout carinate processes bearing a few large spines. There are spines also on the segments of the following pinnules, but the processes are only slightly developed.

The relatively smoothest pinnules are found in the variety *planata*. The processes here are limited to the second and third segments of the lower pinnules, there being on the following segments instead of them a small group of spines. The spines are minute and only visible under a strong magnification.

The distal pinnules are only moderately long.

The pinnules are commonly united by a membrane which incloses their basal segments and extends outward from these. This webbing of the pinnules is most developed in the variety *alata* and is absent in the variety *planata*. It is very variably developed in true *pulchella*.

In the largest specimens the disk has a diameter of from 16 to 18 mm. It is sometimes entirely covered with thick calcareous nodules, and sometimes naked, or only beset with conical calcareous papillae on the anal tube.

Sometimes in the variety *alata* the whole anal area as far as the anal opening is covered with large calcareous warts, while in the other interradial areas these are more scattered. This is the case in a specimen of *pulchella* from *Blake* station 32Ag. In this the warts are not entirely calcified, containing only small calcareous spicules.

The form of these processes on the disk may be, instead of wart-like, papillose or even villous. There are few or none of these in the variety *planata*.

In color, as preserved in alcohol, 2 specimens of *pulchella* from *Blake* station 158 are violet. Some from *Blake* station 45Ag. and from between Martinique and Dominica in 292–695 meters are uniform dark brown. Many specimens of *pulchella* are pure white, and all the specimens of the variety *planata* are uniform brownish white.

Very characteristic of this species is the common occurrence of dark cross bands on the arms which are usually confined to the syzygial pairs, but which sometimes extend over all the brachials between 2 syzygies. Sometimes the proximal portion of the animal as far as the third brachial is dark brown, contrasting sharply with the lighter arms and the very light cirri.

In most specimens of the variety *alata* and in many of *pulchella* the arms carry dorsal longitudinal stripes.

In size, *pulchella*, according to Hartlaub, reaches an arm length of 150 mm. He believes that *alata* scarcely reaches so large a size. The variety *planata* is much smaller, the arms not exceeding 60 mm. in length.

Abnormal specimens.—Dr. P. H. Carpenter (*Challenger* Report, 1888, p. 27; cited by Bather, 1889, and Bateson, 1894) mentioned "a 6-rayed form" of this species, of which he says:

> The disc is unfortunately concealed, so that the symmetry of the ambulacra cannot be made out. But I am rather inclined to think from the appearance of the centro-dorsal that it has the usual pentamerous symmetry, one of the radials being rather larger than its fellows and also axillary, so that it bears two small rays, as sometimes happens in *Allagecrinus*.

Hartlaub says that he did not find this specimen; but it was in the material returned by him; it is among the 5 specimens from *Blake* station 156 included in M. C. Z., 483.

One of the radials is slightly enlarged and axillary, and is followed by 2 IBr series with, as usual, 2 elements each.

In a 10-armed specimen from *Blake* station 45Ag. one of the IBr axillaries bears 2 arms, in both of which the first 2 brachials are united by syzygy. The arm on the right has the next syzygy between brachials 3+4, while that on the left has the next syzygy between brachials 16+17. A still more extraordinary feature is that the IBr axillary bears 2 pinnules, one on either side. Hartlaub suggests that we must assume a fusion between the IBr axillary and the first 2 brachials on each arm.

In the best preserved specimen from *Blake* station 45Ag. there are on one arm syzygies between brachials 2+3 and 4+5. The first pinnule is on the outer side of the epizygal of the first syzygial pair. The first brachial is very long, longer than either syzygial pair, and Hartlaub suggests that it represents 2 brachials which are fused into one.

On one of the outer arms from a IIBr axillary in a specimen from *Albatross* station 2353 the first brachial bears a pinnule, and there is a syzygy between brachials 2+3 as in *Capillaster*.

Localities.—Gulf of Mexico (1, M. C. Z., 26).

Blake station 45Ag.; northwest of the Dry Tortugas, Fla. (lat. 25° 33′ 00″ N., long. 84° 21′ 00″ W.); 185 meters; bottom temperature 16.5° C.; 1877–78 [Hartlaub, 1912] (4, M. C. Z., 460).

Blake station 32Ag.; northern part of the Yucatan Bank (lat. 23° 32′ 00″ N., long. 88° 05′ 00″ W.); 174 meters; 1877–78 [Pourtalès, 1878; Hartlaub, 1912] (5, M. C. Z., 459).

Albatross station 2354; off northwestern Cuba (lat. 20° 59′ 30″ N., long. 86° 23′ 45″ W.); 238 meters; January 22, 1885 (3, U.S.N.M., 34464, 34474). Pl. 6, figs. 14–16.

Albatross station 2353; off northwestern Cuba (lat. 20° 59′ 00″ N., long. 86° 23′ 00″ W.); 305 meters; bottom temperature 17.11° C.; January 22, 1885 (1, U.S.N.M., 34463).

Albatross station 2154; off Habana, Cuba (lat. 23° 10′ 16″ N., long. 82° 22′ 54″ W.); 567 meters; temperature 15.33° C.; April 30, 1884 (1, U.S.N.M., 34478).

Albatross station 2169; off Habana, Cuba (lat. 23° 10′ 28″ N., long. 82° 20′ 27″ W.); 143 meters; May 1, 1884 (1, U.S.N.M., 34479).

Albatross stations 2337; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 21″ W.); 364 meters; coral bottom; January 19, 1885 (4, U.S.N.M.).

Albatross station 2342; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 21″ W.); 369 meters; January 19, 1885 (2, U.S.N.M., 34465, 34600).

Albatross station 2348; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 21″ W.); 386 meters; January 20, 1885 (1, U.S.N.M., 34473).

Albatross station 2345; off Habana, Cuba (lat. 23° 10′ 40″ N., long. 82° 20′ 15″ W.); 337 meters; January 20, 1885 (2, U.S.N.M., 34476).

Albatross stations 2160–2162; off Habana, Cuba (lat. 23° 10′ N., long. 82° 20′ W.); 223–304 meters; April 30, 1884 (1, U.S.N.M., 34469).

Albatross station 2333; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 19′ 12″ W.); 309 meters; January 19, 1885 (1, U.S.N.M., 34472).

Albatross station 2341; off Habana, Cuba (lat. 23° 11′ 00″ N., long. 82° 19′ 06″ W.); 261 meters; January 19, 1885 (1, U.S.N.M., 34470).

Albatross station 2326; off Habana, Cuba (lat. 23° 11′ 45″ N., long. 82° 18′ 54″ W.); 357 meters; temperature 16.67° C.; January 17, 1885 (2, U.S.N.M., 34475).

Albatross station 2320; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 18′ 48″ W.); 238 meters; January 17, 1885 (6, U.S.N.M., 34462, 34466, 34467, 34468). Pl. 5, fig. 10; pl. 7, fig. 21.

Albatross station 2327; off Habana, Cuba (lat. 23° 11′ 45″ N., long. 82° 17′ 54″ W.); 333 meters; January 17, 1885 (2, U.S.N.M., 34471).

Albatross station 2322; off Habana, Cuba (lat. 23° 10′ 54″ N., long. 82° 17′ 45″ W.); 210 meters; January 17, 1885 (2, U.S.N.M., 34599).

Albatross stations 2319–2350; off Habana, Cuba; 60–510 meters; January 17–20, 1885 (3, U.S.N.M., 34477, 34891).

Corwin station 2P, May 24, 1867, or 4P, May 29, 1867; 1.6 miles from La Chorrera, near Habana, Cuba; 493 meters [Hartlaub, 1912] (1+, M. C. Z., 461, 462).[2]

University of Iowa's Bahamas expedition station 10; off Habana, Cuba; 366 meters [H. L. Clark, 1918] (2, U. I.).

Albatross; off Habana, Cuba; 1886 (3+, U.S.N.M., 34625, 34890, 36269). Pl. 5, fig. 12.

Blake station 139; off Mount Eagle, Santa Cruz (lat. 17° 46′ 45″ N., long. 64° 48′ 50″ W.); 398 meters; temperature 10.56° C.; coarse sand; January 7, 1879 [Hartlaub, 1912].

Blake station 134; off Frederickstadt, Santa Cruz (lat. 17° 37′ 15″ N., long. 64° 48′ 20″ W.); 454 meters; temperature 12.50° C.; January 5, 1879 [Hartlaub, 1912] (2, M. C. Z., 463, 464).

Blake station 152; off St. Christopher (St. Kitts) (lat. 17° 12′ 08″ N., long. 62° 41′ 10″ W.); 223 meters; temperature 19.72° C.; January 15, 1879 [Hartlaub, 1912] (1, M. C. Z., 465).

Blake station 148; off St. Kitts (lat. 17° 17′ 12″ N., long. 62° 46′ 43″ W.); 380 meters; temperature 12.89° C.; January 14, 1879 [Hartlaub, 1912] (3, M. C. Z., 192, 403).

Blake stations 155, 156 (both these stations have the same data); off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [Hartlaub, 1912] (7, M. C. Z., 405 [part], 449, 483).

Blake station 157; off Montserrat; 220 meters; January 16, 1879 [Hartlaub, 1912] (3, M. C. Z., 189, 472).

Blake station 158; off Montserrat; 271 meters; January 16, 1879 [Hartlaub, 1912] (5, M. C. Z., 471).

Blake station 189; off Dominica (lat. 15° 18′ 05″ N., long. 61° 24′ 23″ W.); 153 meters; temperature 20.83° C.; fine sand and mud; January 29, 1879 [Hartlaub, 1912] (4, M. C. Z., 186, 475).

Blake; off Dominica and Martinique; 183–512 meters; 1879 (4, M. C. Z., 469).

Cable repair ship *Investigator;* between Dominica and Martinique; 292–695 meters; Capt. E. Cole, 1879 [Hartlaub, 1912].

Blake station 193; off Martinique (lat. 14° 43′ 48″ N., long. 61° 11′ 25″ W.); 309 meters; temperature 10.56° C.; shells, sand, and dark mud; February 5, 1879 [von Graff, 1883, 1884; Hartlaub, 1912] (1, M. C. Z., 466).

Blake station 206; off Martinique (lat. 14° 26′ 18″ N., long. 60° 55′ 00″ W.); 310 meters; temperature 9.44° C.; fine sand; February 10, 1879 [Hartlaub, 1912] (1, M. C. Z., 468).

Blake station 210; off Martinique (lat. 14° 29′ 10″ N., long. 61° 05′ 47″ W.); 349 meters; rough bottom; February 12, 1879 [von Graff, 1883, 1884; Hartlaub, 1912] (1, M. C. Z., 467).

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[2] These specimens are labeled simply "La Chorrera, 250 fathoms" (461) and "off La Chorrera" (462). They could, however, only have come from the *Corwin* collection.

The U. S. Coast Survey steamer *Corwin* in connection with a survey for a telegraph cable between Key West and Habana in 1867 under the direction of Count Pourtalès occupied 4 stations between May 17 and May 29; on the latter date yellow fever broke out on board and the cruise came to an abrupt end. At 2 of the stations, 2P and 4P, the locality was the same and the depths identical. The published records show the depth as 270 fathoms (493 meters) instead of 250 fathoms (457 meters) as given on the labels with the specimens.

Blake station 201 [Hartlaub, 1912]. This station was given by error for station 210 above.

Cable repair ship *Investigator;* off St. Lucia (lat. 13° 52′ N., long. 61° 07′ W.); 508 meters; Capt. E. Cole, 1879 [P. H. Carpenter, 1881; Hartlaub, 1912] (6, M. C. Z., 193, 476).

Blake station 216; off St. Lucia (lat. 13° 51′ 45″ N., long. 61° 03′ 30″ W.); 280 meters; temperature 12.50° C.; fine sand; February 15, 1879 [Hartlaub, 1912] (1, M. C. Z., 478).

Blake station 219; off St. Lucia (lat. 13° 49′ 50″ N., long. 61° 03′ 50″ W.); 276 meters; temperature 13.89° C.; gray sand; February 15, 1879 [Hartlaub, 1912] (3, M. C. Z., 28, 477).

Blake station 290; off Barbados (lat. 13° 11′ 54″ N., long. 59° 38′ 45″ W.); 133 meters; temperature 21.50° C.; coral, sand, and shells; March 9, 1879 [Hartlaub, 1912].

Blake station 287; off Barbados (lat. 13° 11′ 25″ N., long. 59° 38′ 20″ W.); 14–91 meters; coral, sand, and broken shells; March 8, 1879 [Hartlaub, 1912].

Blake station 296; off Barbados (lat. 13° 05′ 24″ N., long. 59° 38′ 45″ W.); 155 meters; temperature 16.39° C.; hard bottom; March 10, 1879 [Hartlaub, 1912] (5, M. C. Z., 487).

Blake station 277; off Barbados (lat. 13° 03′ 55″ N., long. 59° 38′ 25″ W.); 194 meters; temperature 14.44° C.; coral bottom; March 5, 1879 [Hartlaub, 1912] (4, M. C. Z., 485).

Blake stations 277 (above) and 298 (below) (3, M. C. Z., 25).

Blake station 298; off Barbados (lat. 13° 03′ 28″ N., long. 59° 37′ 40″ W.); 220 meters; temperature 16.11° C.; rock bottom; March 10, 1879 [Hartlaub, 1912] (6, U.S.N.M., 34481; M. C. Z., 404). Pl. 5, fig. 11; pl. 6, fig. 13.

Blake station 297; off Barbados (lat. 13° 02′ 36″ N., long. 59° 37′ 45″ W.); 225 meters; temperature 13.61° C.; rock bottom; March 10, 1879 (6, M. C. Z., 190, 405).

Blake station 294; off Barbados (lat. 13° 14′ 18″ N., long. 59° 40′ 10″ W.); 249 meters; temperature 12.50° C.; hard bottom; March 9, 1879 [von Graff, 1884; Hartlaub, 1912] (3, M. C. Z., 484).

Blake station 299; off Barbados (lat. 13° 05′ 00″ N., long. 59° 39′ 40″ W.); 256 meters; temperature 13.61° C.; coral and broken shell; March 10, 1879 [Hartlaub, 1912] (3, M. C. Z., 191, 488).

Blake station 273; off Barbados (lat. 13° 03′ 05″ N., long. 59° 36′ 18″ W.); 188 meters; coral and broken shells; March 5, 1879 [Hartlaub, 1912].

Hassler; off Sandy Bay, Barbados; 183 meters; December 29–30, 1871 [P. H. Carpenter, 1881; Hartlaub, 1912].[3]

Blake station 232; off St. Vincent (lat. 13° 06′ 45″ N., long. 61° 06′ 55″ W.); 160 meters; temperature 16.67° C.; coral bottom; February 21, 1879 [Hartlaub, 1912] (13, M. C. Z., 188, 482).

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[3] On her voyage from Boston to San Francisco in 1871–72 the *Hassler* occupied 8 stations (217P–224P; original Nos. 1–8) off Sandy Bay, Barbados, on December 29 and 30, 1871, four on each day. The depths varied from 31 to 183 meters. The records of the separate stations have not been preserved.

Blake station 231; off St. Vincent (lat. 13° 12′ 10″ N., long. 61° 17′ 18″ W.); 173 meters; temperature 16.39° C.; sand and broken shells; February 20, 1879 [Hartlaub, 1912] (2, M. C. Z., 481).

Blake stations 231 (above) and 224 (below) (6, M. C. Z., 24).

Blake station 224; off St. Vincent (lat. 13° 06′ 36″ N., long. 61° 12′ 45″ W.); 209 meters; temperature 13.89° C.; coral bottom; February 18, 1879 [von Graff, 1884; Hartlaub, 1912] (2, M. C. Z., 480).

Blake station 223; off St. Vincent (lat. 13° 08′ 24″ N., long. 61° 13′ 50″ W.); 267 meters; temperature 13.33° C.; fine black sand; February 18, 1879 [von Graff, 1883].

Blake station 269; off St. Vincent (lat. 13° 07′ 55″ N., long. 61° 05′ 36″ W.); 227 meters; temperature 14.17° C.; coral bottom; March 3, 1879 [P. H. Carpenter, 1881; von Graff, 1883, 1884; Hartlaub, 1912] (27, M. C. Z., 187, 479).

Blake station 241; off Carriacou (lat. 12° 28′ 22″ N., long. 61° 32′ 18″ W.); 298 meters; temperature 11.67° C.; sand and coral; February 24, 1879 [Hartlaub, 1912] (1, M. C. Z., 474).

Blake station 259; off Grenada (lat. 12° 03′ 15″ N., long. 61° 46′ 25″ W.); 291 meters; temperature 11.95° C.; sand and ooze; February 28, 1879 [Hartlaub, 1912] (5, M. C. Z., 470, 491).

Blake station 249; off Grenada (lat. 11° 48′ 15″ N., long. 61° 48′ 45″ W.); 479 meters; temperature 8.33° C.; coarse sand; March 1, 1879 [Hartlaub, 1912] (30, U.S.N.M., 22457, 34480; M. C. Z., 27, 185, 406, 490).

"Probably off Grenada; label lost." (4, M. C. Z., 492.)

West Indies [Pourtalès, 1878] (2, M. C. Z., 494).

Caribbean Sea; 133–508 (?695) meters [P. H. Carpenter, 1881, 1888]; same, but incorrectly quoted as 128–695 meters [Hartlaub, 1891].

No locality (but somewhere in the Caribbean Sea) [Hartlaub, 1912] (1, M. C. Z., 489).

Challenger; St. Paul's rocks; 18–146 meters; August 1873 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Geographical range.—Caribbean Sea, northward to the Yucatan Bank and the Dry Tortugas and southward to St. Paul's rocks.

Bathymetrical range.—From 91 (?14) to 567 (?695) meters; most abundant between 150 and 400 meters. The average of 57 records is 277 meters.

Thermal range.—From 8.33° C. to 21.50° C. Of the 29 records 19 are between 12° and 18° C., with 6 below and 4 above. The average of the 29 records is 14.61° C., or within half a degree of the mean (14.91°) between the 2 extremes.

Occurrence.—This species is an inhabitant of rough bottoms, especially coral bottoms with their interspaces of coral sands and broken shells and a sprinkling, in the Antilles, of volcanic ash.

Remarks.—Stalked barnacles of the genus *Scalpellum* are frequently found on the cirri of this species. In the material examined they occur at *Blake* stations 32Ag., 148, 155–156, 219, 277, 298, 231, 224, and 241.

These stations range from the Yucatan Bank to Carriacou with depths of 161–298 (averaging 213) meters, and temperatures of 11.67°–20.56° C. (averaging 15.28° C.).

History.—This species was originally described by Count Pourtalès in 1878 from 2 specimens (M. C. Z., 494) each with 20 arms from the *Blake* collection, but of which the original label had been lost.

In 1881 Dr. P. H. Carpenter wrote that it had been obtained by the *Blake* at 29 stations in the Caribbean Sea in 1878–79, and once in the previous season, the *Hassler* had dredged it off Barbados, and it had been found by the *Investigator* off St. Lucia and also on the Martinique-Dominica cable.

Carpenter united under the name *pulchella* both the *Antedon alata* and the *Antedon pulchella* described by Pourtalès, preferring the latter name because the former refers to a feature, the perisomic webbing of the pinnules, which, though very marked in some individuals, is barely traceable in others.

In his original description Pourtalès compared *Antedon pulchella* only with *A.* [*Crinometra*] *granulifera*, the description of which is inserted between that of *A. alata* and that of *A. pulchella*, and he seems not to have noticed the close affinity of the 2 last. It was quite natural that he should have done this, for on casual examination *granulifera*, with its granular ornamentation, is intermediate in appearance between the highly ornate *alata* and the smooth *pulchella*.

Carpenter's redescription of *pulchella* is based upon specimens of both *pulchella* and *alata*.

In 1883 von Graff in his report upon the myzostomes of the *Blake* expedition gave a number of definite localities for this species, and in the following year Carpenter published various notes on its anatomy, while von Graff repeated the locality records in connection with his report on the *Challenger* myzostomes.

In 1908 I wrote that the name *alata* must be used for this species instead of *pulchella* since it has page priority, and also since *pulchella* is preoccupied. But according to the accepted rules of nomenclature page priority is without significance in this connection, while, although it is true that the name *pulchella* occurs previously in the genus *Antedon*, *Ganymeda pulchella* of Gray, 1834, being one of the synonyms of *Antedon bifida*, the combination *Antedon pulchella* was never used before so that *pulchella* as the name for this species is perfectly valid.

No additional information regarding this species was forthcoming until 1912 when Hartlaub's memoir on the *Blake* comatulids appeared. He considered this form merely as a variety of *echinoptera*, and recorded the specimens under several different varietal and subvarietal names.

Except in the publications relating to the cruise of the *Blake* in 1878–79 this species has been only once recorded, 2 specimens having been secured off Habana, Cuba, by the University of Iowa's Bahama expedition in 1893, as stated by Dr. Hubert Lyman Clark in 1918.

NEOCOMATELLA ALATA (Pourtalès)

Plate 7, Figure 22

[See also vol. 1, pt. 2, fig. 792 (adambulacral deposits), p. 372]

Antedon alata Pourtalès, Bull. Mus. Comp. Zoöl., vol. 5, No. 9, 1878, p. 215 (Barbados, 100 fathoms; *Hassler;* description).—P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 159 (united with *pulchella*); p. 160, last two footnotes (differential characters).—Bell, Proc. Zool. Soc. London, 1882, p. 532 (listed).—P. H. Carpenter, Proc. Zool. Soc. London, 1882 (1883), p. 746 (synonym of *pulchella*).—A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 6 (history).

Actinometra pulchella (part) P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 160 (the rough armed specimens, and those from *Blake* station 269 mentioned in the second footnote).

Actinometra alata Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 281, 413 (=*echinoptera*).

Actinometra echinoptera var. *pulchella* subvar. *alata* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 419 (discussion); p. 440 (*Blake* stations 249, 106, 277, 298, 294, 224, 269); pl. 18, figs. 9 (part), 10, 14, 15, 16.

Neocomatella ornata A. H. Clark, Proc. Biol. Soc. Washington, vol. 30, 1917, p. 63 (detailed description; *Albatross* station 2321).

Neocomatella alata A. H. Clark, Univ. Iowa, Studies in Nat Hist., vol. 9, No. 5, 1921, pp. 9–11 (occurrence at Barbados); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range).

Diagnostic features.—The distal edges of the brachials are produced and everted, standing out almost at right angles to the axis of the arm, and are bordered with rather coarse spines; this modification of the distal edges of the brachials increases from the second to the eighth after which it is very conspicuous. When this is well developed the profile of the arms recalls that of the arms in the more carinate varieties of *Tropiometra picta*.

Description.—The centrodorsal is discoidal, with a broad, flat, finely pitted polar area 4 mm. in diameter.

The cirri are XIX, 19–21, about 20 mm. long. The first segment is very short, the second is somewhat longer, the third is about as long as broad, and the fourth and fifth are the longest, about twice as long as broad, the fifth being slightly longer than the fourth. The fifth is a transition segment, proximally dull, like the preceding, but highly polished in its distal fourth. The sixth segment is about as long as the fourth, and those following gradually decrease in length, becoming about as long as broad on the eighth or ninth and beyond slightly broader than long. The transition and following segments have the distal dorsal edge prominent. After the seventh the dorsal side rises evenly from the base to the tip so that the segments are trapezoidal in lateral view, which gives the cirri a serrate dorsal profile. After the eleventh segment the proximal half of the dorsal side becomes rather less produced, but the distal half rather more so, so that in lateral view there appears to be a low, broadly rounded dorsal spine on each segment which arises from somewhat more than the distal half of the dorsal surface. In the more compressed distal segments the produced distal dorsal edge, at first crescentic in end view, becomes narrower, but does not lose in height, so that it changes to rounded triangular and, as less of the dorsal surface is involved, appears tubercular. A faint median carination is traceable on the distal half of the later segments. The opposing spine is very low, median in position, involving the entire surface of the penultimate segment, rather slender and moderately curved.

The ends of the basal rays are just visible in the angles of the calyx.

The radials are only slightly visible in the interradial angles over the ends of the basal rays. The IBr_1 are exceedingly short and bandlike, in lateral apposition for rather more than their basal half, but separated by a U-shaped gap distally. The IBr_2 (axillaries) are broadly pentagonal, approximately twice as broad as long, with the lateral edges about as long as those of the IBr_1. The IIBr series are 2. The

IBr_2 and the elements of the IIBr series are rounded dorsally and laterally, and entirely free laterally. The synarthrial tubercles are broad and low, though rather noticeable.

There are 19 arms in the type specimens of *ornata*, which are about 120 mm. long. The first 2 brachials are similar in size and shape, slightly wedge-shaped with the longer side outward, and about twice as broad as the exterior length. The first brachials, like the $IIBr_1$, are united interiorly for nearly their entire length. The second, like the $IIBr_2$, are usually interiorly in apposition with their neighbors, though not united to them. The first syzygial pair (composed of brachials 3 + 4) is about as long as broad. The fifth and sixth brachials are oblong, about twice as broad as long, and those following become very oblique and after the eighth or ninth triangular, about as long as broad, later wedge-shaped, and somewhat less oblique distally. The terminal portion of the arms is not preserved. The elements of the IBr and IIBr series and the first 2 brachials have the dorsal surface thickly covered with small shallow pits. The distal edge of the second brachial is everted and somewhat prominent, tending to form a rounded distal dorsal prominence which is thickly beset with small spines. This condition rapidly becomes intensified distally, the brachials after the eighth having strongly produced distal ends which are armed with a frill of rather coarse spines, these produced distal ends standing out nearly perpendicularly to the axis of the arm. With the gradual narrowing of the arm distally this eversion of the distal ends of the brachials gradually narrows, but does not increase in height, so that on the later brachials it appears as a laterally oblong distal tubercle with the summit thickly studded with small spines standing vertically outward and reaching in height rather more than half the ventrodorsal width of the brachials. In lateral view these tubercles appear as rounded distal spines, the general effect being the same as in the more carinate varieties of *Tropiometra picta*.

Syzygies occur between brachials 1 + 2, and always between brachials 3 + 4; the next syzygy from between brachials 13 + 14 to between brachials 18 + 19, though it is mostly between brachials 17 + 18. The distal intersyzygial interval appears to be from 6 to 8 muscular articulations. The syzygies are exceedingly difficult to detect, as the perisome covering the dorsal surface of the brachials is somewhat swollen and opaque, thus masking the structure beneath.

P_1 is about 15 mm. long, much stouter basally than those succeeding, but tapering with moderate rapidity and slender and flagellate in its distal two-thirds. It is composed of about 40 segments, which at first are about twice as broad as long, more or less rhombic with the corners cut away, but become about as long as broad and squarish after the tenth. The terminal comb is long and arises gradually; it is composed of 25 teeth, which at first are low and after the fifth become bluntly triangular, higher than broad at the base, about as high as the lateral width of the segments bearing them; their apices lean somewhat distally. In the distal part of the pinnule the shape changes somewhat, the last 9 teeth being much more rounded distally, erect, and slightly shorter. The teeth are slightly recurved. P_2 is 8 mm. long, much more slender than P_1 basally and with fewer segments, but otherwise similar to it and with a similar comb. The following pinnules gradually decrease in length to P_6 which is 6 mm. long with a rather small comb. P_6 is rather stouter than P_5, which resembles the pinnules preceding, and P_7 and the following pinnules are stouter still, though slender in the distal half. This stoutness persists in the succeeding pinnules, though in the distal pinnules it is less in extent, occupying only about one-third of their length. The genital pinnules are about 6 or 7 mm. long, stout basally but evenly tapering and becoming slender in the distal half. They are composed of 16 segments, of which the first 3 are twice as broad as long, the fourth is somewhat smaller and proportionately slightly longer, the fifth or sixth is about as long as broad, and the distal are more than twice as long as broad. The distal pinnules are 10 mm. long, with the basal segments large, much broader than long, and those following becoming gradually narrower and proportionately shorter, after the fifth or sixth about as long as broad, and slender and rather more than twice as long as broad distally. The surface of the pinnule segments is rough, and the ends are always more or less spinous. The distal dorsal surface is usually studded with small spines, but is never produced or carinate.

The color in alcohol is white.

Notes.—Hartlaub remarked that all the specimens belonging to the variety *alata* have rather slender cirri.

He further noticed that the amount of eversion of the distal ends of the brachials is variable, and that all intergradations are to be found between specimens with very high processes on the lower brachials and those with smooth arms. Also there are many intergrades between individuals with broad and stout arms and those with narrow and slender arms.

In *alata* the brachials are more closely united than in *pulchella*, or than in the variety called by Hartlaub *planata*. Except for the everted processes standing up at right angles to the axis of the arm, the brachial articulations are smooth. These everted processes occupy a sharply delimited region on the distal border of the brachials; only very rarely do they pass gradually onto the sides so that the rest of the edge of the brachial is roughened.

A feature which Hartlaub considered as especially characteristic of *alata* is the commonly observed broadening of the arms toward the middle, although in this exceptions occur. In many specimens the arms are at first very narrow, but toward the middle they broaden to a most extraordinary degree. This has a pronounced effect on the general appearance of the animal.

In *alata* the position of the syzygies varies in different individuals quite as much as in *pulchella*. In some the intersyzygial interval is from 12 to 14 muscular articulations, while in others it is from 3 to 6.

In *alata* Hartlaub found that the division series are free laterally, the only exception being a single 19-armed specimen from *Blake* station 269, in which in one place the IBr_2 (axillaries) are in close lateral contact.

A complete absence of IIBr series is rare. In all the material belonging to species of the genus *Neocomatella* studied by Hartlaub he found only 13 such cases, including one the identification of which was uncertain. Of these 13 specimens, 5 belonged to *alata;* in 3 of these the characters were strongly marked, in the other 2 they were intermediate. It thus follows that in *alata*, of which Hartlaub studied 11 typical and 6 intermediate specimens, the percentage of 10-armed individuals is higher than in *pulchella*.

Of the 11 specimens of *alata* examined by Hartlaub, 3 had 11 arms and one had 13 arms; of the type specimens, 1 has 11 and the other 12 arms. Of the specimens of *alata* seen by Hartlaub, only 2, one from *Blake* station 249 and the other from *Blake* station 232, had 20 arms.

As in *pulchella* the decrease in size of the proximal pinnules may be very gradual, or P_2 may be abruptly shorter than P_1. This latter condition occurs in 2 specimens from *Blake* station 294, one of which is referable to *alata*, the other to *pulchella*.

The processes on the pinnule segments are very strongly developed and assume the character of high keels. They are most strongly developed on the pinnules of those specimens in which the brachials also have very strong processes on the distal ends. The spines on the carinate processes of the pinnule segments are smaller than the corresponding spines in *pulchella*. On the first 3 pinnules the processes themselves, in correlation with the character of the brachials which bear them, are less developed than on those following.

In *alata* the segments of the distal pinnules are relatively broad and strongly spinous.

Sometimes, as in a specimen from *Blake* station 249, the whole anal area as far as the anal opening is covered with large calcareous warts, these being more scattered in the other interradial areas.

In most specimens there are dark dorsal longitudinal stripes on the arms.

Hartlaub believes that *alata* scarcely reaches so large a size as *pulchella*.

Of the specimens from *Albatross* station 2331, one is a small but very typical example with 14 arms, and the other is a very small specimen with 10 arms.

A very young 10-armed specimen from *Blake* station 269 and another from *Blake* station 277 in spite of their small size show the characteristic features of *alata* to a marked degree. The IBr_1 in the one from station 277 are very close together, and in the one from station 269 are already in lateral contact. In both the arms are narrow at the base and gradually broaden toward the middle.

From *Blake* station 298 there is a young individual undergoing adolescent autotomy; the IIBr axillary and the 2 arms borne by it are very small. The cirri have 3 short basal segments. The IBr_1 are laterally free. The seventh-fourteenth brachials have the characteristic strong everted processes on the pinnule side of the distal border. The brachials are relatively short. Most of the arms are markedly broadened in the middle, up to about the thirtieth brachial. The cirri are rather short, with about 20 segments. The color is uniform light brown.

The specimen from *Blake* station 294 has between 16 and 20 arms.

The 2 *Hassler* specimens are the originals from which the species was described. Both are young and much broken. One has 11, the other 12 arms. The centrodorsal is small. In one the cirri are in a single marginal row, in the other in a partially double marginal row. The cirri are slender and rather short; the relative shortness of the fourth and fifth segments is noteworthy. In this they agree with a typical 19-armed specimen from *Blake* station 269. The IBr_1 are laterally free and rounded. The color is light grayish yellow, with the syzygial pairs and the adjacent parts darker. Each brachial has the half of the distal edge on the pinnule side abruptly everted and produced directly outward in the form of a high flange.

Of the specimens from *Blake* station 269, one with 10 arms and one with 13 have the *alata* character developed to an extreme degree; another with 18 arms is not so extreme.

A specimen from *Blake* station 232 has 20 slender arms which are only very slightly broadened in the middle.

There are 2 rows of cirri on the centrodorsal. The cirri have 3 short basal segments, and sometimes the fourth also is not elongated; the fifth and sixth segments are always long, and those following short. Dorsal spines are developed from the sixth or seventh segment onward. There are 20+ segments.

The radials are only visible in the interradial angles. The IBr_1 are in the closest lateral contact. On each ray the 2 IIBr series are interiorly in the closest contact and are sharply flattened against each other. The arm bases are broad and lie close together. Slight synarthrial tubercles are developed in the division series. There is a small depression on the dorsal side of the axillaries.

The high eversion of the brachials begins with the third, sometimes even with the second; it increases rapidly in size and extends for varying distances along the arms, but beyond the twenty-fourth brachial the profile of the arm becomes smooth again. On one arm the seventh-seventeenth brachials have extraordinarily developed eversions, while from the eighteenth on the brachials are almost smooth.

Syzygies occur between brachials 1+2 and 3+4, the next from between brachials 21+22 to between brachials 36+37, and the following after an interval of from 12 to 14 muscular articulations; on one arm there is another syzygy 12 muscular articulations further on.

The color is uniform light brown, some of the arms with a dark longitudinal band on the dorsal surface. The dorsal portion of the animal as far as the third brachials is darker. The cirri are light.

Hartlaub remarks that this specimen and another from *Blake* station 249 differ from the types of *alata* especially in the close approximation of the rays, and the apparent tendency of these to come into lateral contact.

A specimen from *Blake* station 249 has the centrodorsal with a central concavity. The cirri are arranged for the most part in a single marginal row. There are 20+ cirrus segments of which the 3 first, and sometimes also the fourth, are short; the fifth and sixth are always elongated, and those following are short. Dorsal spines are developed from the sixth or seventh onward.

The radials are only visible in the interradial angles of the calyx. The IBr_1 are in the closest lateral contact. The division series are broad and lie very close together. The $IIBr_1$ are interiorly in close contact, though this is not always true of the IIBr axillaries. Slight synarthrial tubercles occur in the division series.

The general habitus of the animal is robust. There are 20 arms which are narrow at the base but gradually broaden, becoming in the middle unusually broad.

Syzygies occur between brachials 1+2 and usually 3+4, sometimes 4+5 or 5+6; the next is from between brachials 18+19 to between brachials 23+24, and those following occur at intervals of from 7 to 9, distally 5, muscular articulations.

The 2 first syzygial pairs are about as long as broad. The 2 brachials following are short and oblong, and those succeeding are short triangular; at about the thirtieth the length slowly decreases and the brachials become irregularly wedge-shaped.

The extent of the eversion of the distal edges of the brachials varies on different arms. Usually it ends at the twenty-fourth brachial, the arm being smooth from that point onward, but on one arm the last trace of the eversion is at about the thirty-fifth brachial.

P_1 is 14 mm. long with 35 segments. P_2 is 10 mm. long with 27 segments. P_3 is about as long as P_2. P_4 is 6 mm. long with 17 segments. P_5 is somewhat shorter. On the following pinnules the length slowly increases.

On the outer side of the arms only the first 3 pinnules are flagellate. All 3 have prominent combs, that of P_1 extending from the twentieth to the thirty-second segments, and that of P_3 extending from the fifteenth segment to the twenty-fifth (terminal). The segments in the proximal half of the first 3 pinnules are only slightly broader than those in the following shorter pinnules. The 2 basal segments have no processes nor spines.

From P_4 onward the segments following the second increase markedly in size and are surrounded by skinlike perisome. From the third onward the segments of all the pinnules bear a spinous carinate process on the side toward the arm. On the flagellate first 3 pinnules these processes are only occasional on the third-sixth or -seventh segments, and when present are only moderately developed. On the following pinnules the strength of these processes markedly increases, and on P_7 or P_8 they are already as broad as the entire segment that bears them.

The processes on the pinnule segments are strongest in the region where the eversion of the distal edges of the brachials is also strongest. On the pinnule of the fifteenth brachial the processes extend from the third to the eleventh segments. On the outer pinnules, from about the forty-fifth brachial on, they extend only from the third to about the sixth, and their development here is much less.

The length of the pinnule of the eightieth brachial reaches 10 mm. These distal pinnules are flagellate and are composed of uniformly short segments, of which only the 2 basal are enlarged. There are feebly developed processes from the third to about the twelfth segments.

The color is whitish, with the syzygial pairs brownish, and sometimes with a dark longitudinal band on the dorsal surface of the arms. The central portion, as far as the third brachials, is darker. The cirri are light.

A 15-armed specimen from *Blake* station 262 has unusually short brachials.

A 20-armed specimen from *Blake* station 249 has the varietal characters developed to an extreme degree, while a 17-armed specimen from the same station is intermediate.

Localities.—*Blake* station 106; Old Bahama Channel (lat. 22° 23′ 45″ N., long. 77° 38′ 20″ W.); 493 meters; fine white sand; December 16, 1878 [Hartlaub, 1912].

Albatross station 2331; off Habana, Cuba (lat. 23° 10′ 31″ N., long. 82° 19′ 55″ W.); 208 meters; coral bottom; January 17, 1885 (2, U.S.N.M., 34483).

Albatross station 2334; off Habana, Cuba (lat. 23° 10′ 42″ N., long. 82° 18′ 24″ W.); 122 meters; white coral; January 19, 1885 (2, U.S.N.M., 34614).

Albatross station 2321; off Habana, Cuba (lat. 23° 10′ 54″ N., long. 82° 18′ 00″ W.); 420 meters; fine gray sand; January 17, 1885 [A. H. Clark, 1917] (2, U.S.N.M., 34482). Pl. 7, fig. 22.

Albatross stations 2319–2350; off Habana, Cuba; 60–510 meters; January 17–20, 1885 (2, U.S.N.M., 34885, 36093).

Blake station 277; off Barbados (lat. 13° 03′ 55″ N., long. 59° 38′ 25″ W.); 194 meters; temperature 14.44° C.; coral bottom; March 5, 1879 [Hartlaub, 1912] (2, M. C. Z., 485).

Blake station 298; off Barbados (lat. 13° 03′ 28″ N., long. 59° 37′ 40″ W.); 220 meters; temperature 16.11° C.; rock bottom; March 10, 1879 [Hartlaub, 1912].

Blake station 294; off Barbados (lat. 13° 14′ 18″ N., long. 59° 40′ 10″ W.); 249 meters; temperature 12.50° C.; hard bottom; March 9, 1879 [Hartlaub, 1912].

Hassler; off Sandy Bay, Barbados; 183 meters; December 29–30, 1871; for further details see footnote, p. 140. [Pourtalès, 1878; P. H. Carpenter, 1881; Hartlaub, 1912] (2, M. C. Z., 493).

Cable repair ship *Investigator;* off St. Lucia (lat. 13° 52′ N., long. 61° 07′ W.); 508 meters; Capt. E. Cole (1, M. C. Z., 193).

Blake station 269; off St. Vincent (lat. 13° 07′ 55″ N., long. 61° 05′ 36″ W.); 227 meters; temperature 14.17° C.; coral bottom; March 3, 1879 [P. H. Carpenter, 1881; Hartlaub, 1912] (4, M. C. Z., 187, 479).

Blake station 232; off St. Vincent (lat. 13° 06′ 45″ N., long. 61° 06′ 55″ W.); 160 meters; temperature 16.67° C.; coral bottom; February 21, 1879 [Hartlaub, 1912] (3, M. C. Z., 188, 482).

Blake station 224; off St. Vincent (lat. 13° 06′ 36″ N., long. 61° 12′ 45″ W.); 209 meters; temperature 13.89° C.; coral bottom; February 18, 1879 [Hartlaub, 1912].

Blake station 262; off Grenada (lat. 12° 01′ 45″ N., long. 61° 47′ 25″ W.); 168 meters; temperature 16.67° C.; fine sand; March 1, 1879 [Hartlaub, 1912].

Blake station 249; off Grenada (lat. 11° 48′ 15″ N., long. 61° 48′ 45″ W.); 479 meters; temperature 8.33° C.; coarse sand; March 1, 1879 [Hartlaub, 1912] (3, M. C. Z., 490).

Geographical range.—From the Bahamas and Cuba southward to Grenada.

Bathymetrical range.—From 122 to 508 meters. The average of 14 records is 274 meters.

Thermal range.—From 8.33° to 16.67° C. The average of 8 records is 14.09° C.

Remarks.—Pourtalès in 1878 first described this form from a specimen which had been dredged by the *Hassler* in 183 meters off Barbados.

In the original description Pourtalès especially mentions that the distal edge of the brachials "is raised in the shape of a serrated scale on the side nearest the pinnule, particularly about the middle of the arm." He also states that "a membranous expansion borders the arms, embracing three or four joints of the pinnules and fringing the latter also in proportion. This expansion is greatest toward the end of the arm."

In 1881 Carpenter, in his preliminary report upon the *Blake* comatulids, united *alata* and *pulchella* under the latter name. He preferred this to *alata*, since *alata* he supposed to refer to the lateral extension of the ventral perisome described by Pourtalès which he rightly considered a very variable character well marked in some individuals but barely traceable in others.

He gives a detailed description of "*Actinometra pulchella*," which includes both the *pulchella* and *alata* types, and refers especially to the latter in a footnote.

In his report upon the *Blake* comatulids, which was published in 1912, Hartlaub rightly considered that Pourtalès' name *alata* referred to the processes developed upon the distal edges of the brachials, and not to the perisomic webbing along the sides of the arms as Carpenter had supposed. He recorded this form, which he gives as a subvariety of *Actinometra echinoptera* var. *pulchella,* from a number of different stations.

In studying the West Indian comatulids collected by the *Albatross* I found a highly ornate form of *Neocomatella pulchella,* and, misled by Carpenter's interpretation of the origin of the name *alata,* I never thought of comparing it with this type, but in 1917 described it as new under the name of *Neocomatella ornata.* After the return of the *Blake* material I visited the Museum of Comparative Zoölogy and examined the specimens, making the discovery that my *ornata* was identical with Pourtalès' *alata* described almost 40 years previously.

NEOCOMATELLA EUROPAEA A. H. Clark

Comatule Parfait, Rapport sur la campagne scientif. du Talisman en 1883, 1884, p. 41 (off Cape Spartel [35° 26′ N., 9° 09′ E.], 717 m., June 10, 1883); p. 55 (25° 41′ N., 18° 16′ W., 410 m., July 9, 1883).—de Folin, Sous les mers, 1887, pp, 266, 297 (same localities).

Actinometra pulchella (not of Pourtalès, 1878) P. H. Carpenter, Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 369 (*Porcupine* station 31, 1870; discussion; *Dacia,* 34° 57′ N., 11° 57′ W., 533 fathoms); p. 372 (*Porcupine* station 31, 1870); *Challenger* Reports, Zoölogy, vol. 11, pt. 32, 1884, p. 137 (coast of Morocco, in moderately deep water); *Challenger* Reports, Zoölogy, vol. 26, pt. 60, 1888, p. 304 (localities; discussion); pl. 52, fig. 1; Journ. Linn. Soc. (Zool.). vol. 24, 1891, p. 68, footnote (occurs on both sides of the Atlantic).—Koehler, Revue biol. du nord de la France, vol. 7, 1895, p. 477 (*Caudan* records; notes); Annales de l'Université de Lyon, vol. 26, Resultats scientifique de la campagne du *Caudan,* June 1896, p. 99 (*Caudan* stations 4, 5, 14, 16, 19, 24; characters).—D'Arcy Thompson, Proc. Roy. Soc. Edinburgh, vol. 22, 1899, p. 322 (range).—Springer, Mem. Mus. Comp. Zoöl., vol. 25, No. 1, 1901, p. 88 (range).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—Koehler and Vaney, Bull. du mus. d'hist. nat., Paris, 1910, No. 1, p. 26 (collected by the *Travailleur* or the *Talisman*); p. 32 (off Cape Peñas, July 12, 1882, 400 m.; 35° 26′ N., 9° 09′ W., 717 m.; 25° 41′ N., 18° 16′ W., 410 m.).—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (of P. H. Carpenter, 1888, includes *Palaeocomatella difficilis, Neocomatella europaea,* and *N. atlantica*).—W. de Morgan, Journ. Mar. Biol. Assoc., new series, vol. 9, No. 4, March 1913, pp. 539, 540 (*Huxley* stations 7, 13).

Actynometra pulchella Filhol, La vie au fond des mers, 1885, p. 213 (from Carpenter).

Actinometra W. Marshall, Die Tiefsee und ihr Leben, 1888, pp. 240, 241.

Neocomatella, sp. nov., A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 7 (northwestern Africa); p. 15 (references to and localities of African specimens).

Neocomatella europaea A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 4 (published references to the specimen in the British Museum; *Porcupine* station 31, 1870; characters); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).

Diagnostic features.—The cirri are rather slender, with relatively few segments, of which the proximal are much elongated, the fourth, which is the longest, being four times as long as broad, or even rather longer. The cirri are XXIII–XXVIII, 13–15 (usually 14–15); the arms are usually 20, in the material which I have studied up to 50 mm. in length.

Description.—The centrodorsal is broad, flattened, and sometimes even depressed. The cirri are marginal.

The cirri are X–XXVIII, 13–15; the first segment is very short, the second is slightly longer, the third is much longer, and the fourth is longer still, from three to four times as long as broad; the fifth is slightly shorter, of the same length as the third, and the segments following decrease regularly in length, though they always remain slightly longer than broad. The distal segments bear a very short dorsal spine.

The radials are wholly concealed. The IBr_1 are partially visible, and are free laterally. IIBr series are always present, usually in the full number. IIIBr series occur, but are very rare.

The arms are 17–20 (usually 20) in number, about 50 mm. long.

The mouth is slightly excentric.

The color in alcohol is dark gray fading to white.

Notes.—In the single specimen from *Porcupine* station 31, which was figured by Carpenter in 1888, there are 20 arms; one of the IIBr series is lacking, but the deficiency is made up by the occurrence of a single IIIBr series, which is externally developed. A single cirrus stump with 4 segments remains. The cirrus segments are unusually long, the fourth being four times as long as broad, or even rather longer.

Four specimens from *Huxley* station 13 were kindly sent me for examination by Dr. E. J. Allen, the director of the Marine Biological Station at Plymouth, England. In the largest the cirri are X, 13–14; the fourth segment is the longest, about four times as long as the median width. There are 17 arms, which are about 50 mm. long. Another specimen, much broken but apparently of the same size, has exactly 20 arms, all of the IIBr series being present. The other 2 are smaller, with 12 and 10 arms, respectively.

Koehler noted that usually on the outer arms arising from each IIBr series the first syzygy is between brachials 3+4, while on the inner arms it is between brachials 1+2; on these inner arms there is usually another syzygy between brachials 3+4, but this may be absent.

Localities.—*Talisman* station 72; off Las Huertas, Rio de Oro (lat. 25° 41′ N., long. 15° 56′ W.); 410 meters; muddy sand and corals; July 9, 1883 [Parfait, 1884; de Folin, 1887; Koehler and Vaney, 1910; A. H. Clark, 1911].

Dacia; northeast of the Seine Bank, west of the Straits of Gibraltar (lat. 34° 57′ N., long. 11° 57′ W.); 974 meters [P. H. Carpenter, 1884, 1888; A. H. Clark, 1911].

Talisman station 10; southwest of Cape Spartel, Morocco (lat. 35° 26′ N., long. 6° 49′ W.); 717 meters; bottom temperature 12.0° C.; mud; June 10, 1883 [Parfait, 1884; de Folin, 1887; Koehler and Vaney, 1910; A. H. Clark, 1911].

Porcupine station 31; west of the Straits of Gibraltar (lat. 35° 56′ N., long. 7° 06′ W.); 872 meters; bottom temperature 10.28° C.; clay; August, 1870 [P. H. Carpenter, 1884, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

Porcupine station 25; near Cape St. Vincent, southwestern Portugal (lat. 37° 11′ N., long. 9° 07′ W.); 684 meters; bottom temperature 11.95° C.; rock; July 27, 1870 [P. H. Carpenter, 1888].

Travailleur; off Cape de Peñas, northern coast of Spain, west of Gijon; 400 meters; July 12, 1882 [Koehler and Vaney, 1910; A. H. Clark, 1911].

Caudan station 14; Bay of Biscay (lat. 44° 05′ N., long. 4° 45′ W.); 960 meters; mud [Koehler, 1896].[4]

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[4] There seems to be some doubt regarding this station. In his preliminary report Professor Koehler gives station 14; but the accompany data are those of station 4. In this final report he gives station 4, but with the depths of stations 2 and 3, and also station 14, with the depth of station 4.

Caudan station 19; Bay of Biscay (lat. 45° 18′ N., long. 6° 23′ W.); 400 meters; mud [Koehler, 1896].

Caudan station 16; Bay of Biscay (lat. 45° 38′ N., long. 5° 53′ W.); 1,220 meters; corals and mud [Koehler, 1896].

Caudan station 5; Bay of Biscay (lat. 45° 47′ N., long. 6° 15′ W.); 1,700 meters; corals and mud [Koehler, 1896].

Caudan station 4; Bay of Biscay (lat. 45° 57′ N., long. 6° 21′ W.); 1,410 meters; corals and mud [Koehler, 1896].

Caudan station 24; Bay of Biscay (lat. 46° 40′ N., long. 6° 58′ W.); 400–500 meters; corals [Koehler, 1896].

Huxley station 7; northern part of the Bay of Biscay (lat. 47° 36′ N., long. 7° 31′ W.); 812 meters [de Morgan, 1913].

Huxley station 13; off Brittany (lat. 48° 07′ 30″ N., long. 8° 13′ 00″ W.); 753 meters; sand, mud and hard ground; August, 1906 [de Morgan, 1913] (4 Mar. Biol. Assoc.).

Geographical range.—From Rio de Oro, northwest Africa, northward to the northern part of the Bay of Biscay.

Bathymetrical range.—From 400 to 1,700 meters; the average of 14 records is 814 meters.

Thermal range.—From 10.28° to 12° C.; the average of the 3 records is 11.41° C.

Occurrence.—This species, like its Caribbean relatives, lives on rough bottom with arborescent growths usually described as "corals." Koehler noted that all of the specimens captured by the *Caudan* were fixed by their cirri to colonies of *Lophohelia* and *Amphihelia*.

Koehler remarked that this form (or the common Caribbean type, which he regarded as conspecific with it) has been found in the vicinity of the Bermudas; the Bahamas are the islands to which he intended to refer.

Remarks.—This species was first brought to light by the *Porcupine*, which dredged a single mutilated individual at station 31 in 1870. In recording this specimen in 1884 Carpenter mentioned others which had been secured by the cable-repair ship *Dacia*. Carpenter referred these examples to the Caribbean *pulchella*, and gave no information regarding them further than to say that the *Porcupine* specimen had 20 arms, one of the IIBr series being absent and one IIIBr series being present.

In the *Challenger* report on the stalked crinoids, published in the same year, Carpenter's reference to specimens of *Actinometra pulchella* dredged in moderately deep water off the coast of Morocco is based upon the *Dacia* material.

In the *Challenger* report upon the comatulids published in 1888 Carpenter listed this species from *Porcupine* stations 25 and 31 in 1870, from the *Dacia* locality off the coast of Morocco, and from off Rochefort in 1,500 meters. This last record is based upon an illustration of the sea bottom in 45° 59′ 30″ N. lat., 6° 29′ 30″ W. long., in 1,500 meters, published by Filhol in 1884 (La Nature, vol. 12, p. 329) and republished by him in 1885 (La vie au fond des mers, between pp. 10 and 11), in which there appears conspicuously a large unnamed multibrachiate comatulid which was identified by Carpenter as this species.

But Koehler and Vaney found that the only comatulid dredged at this locality (*Talisman* station 156, 1,480 meters, August 30, 1883) was a single specimen of *Crotalometra porrecta* and the figure certainly suggests this species much more than it does *Neocomatella europaea*.

Carpenter gave only a very meager account of this form, which he intended to describe in detail in connection with his report on the *Blake* collections; but he published an excellent figure of the *Porcupine* specimen which he had recorded in 1884.

In 1895 and again in 1896 Prof. René Koehler recorded this type from six *Caudan* stations in the Bay of Biscay and published notes upon his specimens, and in 1910 he, in collaboration with Prof. Clement Vaney, listed the localities at which it had been secured by the *Travailleur* and by the *Talisman*.

In 1910 the present author examined at the British Museum the original *Porcupine* specimen recorded in 1884 by Carpenter, which seemed to him to differ so much from the West Indian type with which he was familiar through his study of the *Albatross* collections as to merit the status of a distinct species. In his memoir on the crinoids of the coasts of Africa, published in 1911, he therefore listed the African localities from which this form is known under the heading "*Necocomatella* (new species)" in the hope that Professors Koehler and Vaney in their final report upon the *Travailleur* and *Talisman* collections would give it a name.

In his notes upon the recent crinoids in the collection of the British Museum the original *Porcupine* specimen is included under the name of *Neocomatella europaea*, and its essential features are briefly mentioned.

The only further reference to this form is by W. de Morgan, who in 1913 added two localities to its known range as a result of the dredging operations of the *Huxley*.

Genus PALAEOCOMATELLA A. H. Clark

Actinometra (part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 93, and following authors.

Palaeocomatella A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (diagnosis; genotype *Actinometra difficilis* P. H. Carpenter, 1888); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 3 (in key); p. 7 (diagnosis; genotype).—GISLÉN, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 38 (brachial homologies).

Diagnosis.—A genus of Capillasterinae in which the arms are more than 10 in number, all of the division series are 2, the first pinnule of the undivided arms is on the second brachial, there is always a syzygy between brachials 3+4 on the outer and between brachials 1+2 on the inner arms, and the first 4 brachials are usually grouped in 2 syzygial pairs; the brachials beyond the basal are triangular and about as long as broad; and the centrodorsal is large with the cirri arranged in 25 closely crowded and irregular columns of usually 2 each.

Geographical range.—From the Kei to the Philippine Islands.

Bathymetrical range.—From 256 to 275 meters.

Remarks.—This genus is known only from a single species represented by 2 mutilated individuals. It seems to differ from *Neocomatella* only in the large centrodorsal upon which the cirrus sockets are arranged in more or less evident columns. Carpenter referred the *Challenger* specimen to *Actinometra* (*Neocomatella*) *pulchella*.

PALAEOCOMATELLA DIFFICILIS (P. H. Carpenter)

Plate 7, Figures 23, 24

Actinometra difficilis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 93 (elements of the IBr and IIBr series and first 2 brachials united by syzygy; refers to pl. 52, fig. 2 which, however, is labeled *pulchella*).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (made genotype of *Palaeocomatella*).

Actinometra pulchella P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 304 (specimen from station 192); pl. 52, fig. 2.—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 35 (East Indian specimen recorded by Carpenter is *maculata* [error]); p. 37 (of Hartlaub, 1891=*maculata*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (of P. H. Carpenter, 1888=*Palaeocomatella difficilis*+*Neocomatella europaea*+*N. atlantica*).

Palaeocomatella difficilis A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 2 (published references to specimen in the B. M.; *Challenger* station 192; discussion); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 8 (detailed description and discussion; station 105); p. 273 (listed); pl. 11, figs. 1, 2.

Description.—The centrodorsal is thin discoidal, circular in outline, the broad polar area flat, 3 mm. in diameter, with a slightly elevated rim; the cirrus sockets are closely crowded, and are arranged in 25 columns of 2 (more rarely 1) each.

The cirri are about XXX, 10–11, 6 mm. long, with the distal portion strongly curved. The first segment is very short, the second is nearly or quite twice as long as the median width and is strongly constricted centrally, and the third is from three to four times as long as the median width, a transition segment, slightly constricted centrally with a swollen distal end. The fourth segment is from half again to twice as long as its proximal width, expanding evenly from the proximal to the distal end; the next 2 segments are about as long as their proximal width, and the remainder are slightly shorter than the proximal width. The fourth segment has a slight subterminal median dorsal tubercle; on the next 3 segments this gradually increases in size and moves to a central position. The opposing spine, though slightly larger than the tubercle on the preceding segment, is very small; it is subterminal in position and sharp. The terminal claw is twice as long as the penultimate segment, long, moderately slender, and moderately and evenly curved. The distal portion of the cirri is moderately compressed.

The ends of the basal rays are visible as minute tubercles in the angles of the calyx.

The radials are entirely concealed. The IBr_1 are concealed in the median line, but are partially visible in the interradial angles; their lateral edges diverge from those of the adjacent IBr_1 at approximately a right angle. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long, with the lateral edges slightly concave and the anterior angle sharp; they are widely separated from their neighbors. The IIBr series are 2; the $IIBr_1$ are very short, slightly wedge-shaped, about four times as broad as the greater (outer) length, almost entirely united interiorly. The $IIBr_2$ (axillaries) are broadly pentagonal, twice as broad as long, with the lateral edges from one-half to two-thirds the length of those of the $IIBr_1$. The union of the elements of the IBr series is extremely close and with difficulty distinguishable from a syzygy.

The 20 arms were probably about 50 mm. long; the brachials following the basal syzygial pairs as far as the seventh are wedge-shaped, twice as broad as the median length, with the anterior edges concave and slightly produced and spinous; after the seventh the brachials become triangular, about as long as broad, with the distal edges concave.

The first syzygy is normally between brachials 3+4 on the external arms, and brachials 1+2 on the internal; but in many cases the first 4 brachials are grouped in 2 syzygial pairs.

P_1 is 9 mm. long, very slender, with 35 short segments; the comb has 18 teeth, of which the distal 10 or 11 are abruptly larger than those preceding, long and lance-shaped, longer than the width of the segments which bear them. P_2 is 5.5 mm. long, much more slender than P_1, but otherwise similar. P_3 is similar to P_2, but is slightly smaller and shorter. P_4 is 3.3 mm. long with 17 segments, of which the distal bear traces of a comb. P_5 is very small and slender, 3 mm. long, with no trace of a comb.

Notes.—In 1910 I examined the single much broken specimen from *Challenger* station 192 in the British Museum. The cirri have 16–17 segments, of which the third, a transition segment, is the longest, about three and one-half times as long as its median width, and is slightly constricted centrally. The cirri are relatively very long, the distal end of the second segment being nearly as far from the center of the animal as the distal angle of the IIBr axillary. The outer cirrus segments have rather strong dorsal processes.

Carpenter's figure of this same specimen is essentially correct, excepting in the proportions of the cirrus segments. It shows an individual larger than the one described (from *Siboga* station 105) with a very broad discoidal centrodorsal circular in outline, which is about 4 mm. in diameter. The radials are wholly and the IBr_1 are almost entirely concealed by the centrodorsal. The cirri as shown are about XV, with 16 segments, and are 12 mm. long. The longest segments (fourth and fifth) are drawn twice as long as broad basally, while the distal are about as broad as long.

Dr. Torsten Gislén has recently examined the specimen, and he writes me that the cirri stand mostly in a single row; where there is a second row there is no arrangement in definite columns.

Localities.—*Challenger* station 192; near the Kei Islands (lat. 5° 49′ 15″ S., long. 132° 14′ 15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1912, 1913, 1918] (1, B. M.).

Siboga station 105; near Jolo (Sulu), Philippine Islands (lat. 6° 08′ N., long. 121° 19′ E.); 275 meters; coral bottom; July 4, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.). Pl. 7, figs. 23, 24.

Remarks.—In the *Challenger* report (p. 93) Carpenter refers to the figure of the specimen from station 192 under the name of *Actinometra difficilis*, and says of it (and also of *Actinometra paucicirra*) that "the two outer radials, the two distichals, and the first two brachials are respectively united by syzygy." This is the only reference to the name *difficilis*, which is not mentioned in the index.

Later (p. 306), under the heading *Actinometra pulchella*, he says:

> Among the numerous comatulids which were dredged at Station 192 in the Arafura Sea was a single mutilated specimen which has given me very great trouble. Three of the rays which are preserved have bidistichate series, and the first two brachials above the axillaries are clearly united by syzygy, the radiating ridges being very distinct on the exposed distal faces of two of the first

brachials. But I have had much difficulty in determining the nature of the union between the two outer radials and the two distichals respectively; and after repeated changes of opinion, I have come to the conclusion that there is a bifascial articulation in each case. The specific formula thus becomes the same as that of *Actinometra pulchella*, and in the absence of better preserved material it has seemed best to refer the individual in question to this protean species. The eastern form has fewer cirrus-joints, with larger and blunter spines than may occur in the Caribbean type; and the characters of the lower pinnules do not seem to be quite the same in the two cases. But I have been unable to make out any differences which would serve to separate the two forms specifically, though it is quite possible that they may reveal themselves when better preserved material is examined. On the other hand, there is no *a priori* reason why *Actinometra pulchella*, which occurs on both sides of the Atlantic, should not also inhabit the Eastern Seas. * * *

On the whole, then, it appears most probable that the specimen obtained by the *Challenger* in the Arafura Sea really does belong to *Actinometra pulchella*, though one would like to see a more perfect specimen before definitely making such a large addition to the geographical range of the Caribbean type. It is also possible, on the other hand, that we are here dealing with a varietal form of *Actinometra maculata* from Torres Strait; but I rather doubt this being the case, as its arm joints are relatively longer than those of that type, and the terminal cirrus joints are more compressed laterally.

Genus CAPILLASTER A. H. Clark

Asterias (part) Linné, Syst. Nat., ed. 10, vol. 2, 1758, p. 663.

Asterias (*Ophiura*) Oken, Lehrb. d. Naturgesch., 3 Thiel, 1815, p. 356.

Comatula (part) Lamarck, Hist. nat. des animaux sans vertèbres, vol 2, 1816, pp. 533, 534.

Alecto (part) J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 185.

Comatula (*Alecto*) (part) J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 261.

Actinometra (part) Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 210.

Antedon (part) Lütken, Vidensk. Meddel., 1871, p. 273.

Comatula (*Actinometra*) (part) Grube, Jahresber. d. schles. Gesellsch. f. vaterl. Cultur, vol. 53, 1875, p. 75.

Comaster (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Phanogenia (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124.

Capillaster A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (characters; genotype *Actinometra sentosa* P. H. Carpenter, 1888); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 503 (synonymy; genotype; range); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 150 (arm division compared with that of *Hypalocrinus liliaceus*); p. 175 (referred to the Capillasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 121 (multibrachiate when very small; individuals of this genus and *Nemaster* are more solitary than are those of other genera of Comasteridae); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represented in the West Indies by *Nemaster*); p. 13 (common to southeast Africa and Ceylon, but not occurring in the Arabian Sea); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (*Comissia* falls in the same subfamily); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 735 (1 species in Australia); p. 736 (original reference; characters; range; represented in the West Indies by *Nemaster*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 390 (relation to *Nemaster*, *Neocomatella*, and *Comatella*); Crinoids of the Indian Ocean, 1912, p. 11 (represented in the Ceylon region which is the western limit of the large and highly multibrachiate species); p. 12 (represented in the southeast African region); p. 13 (corresponds to the West Indian *Nemaster*); p. 20 (bathymetric range); p. 55 (in key); p. 73 (original reference; type); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 3 and following (represents the Atlantic *Nemaster*); Beiträge zur Kenntnis d. Meeresfauna Westafrikas, Echin. II, Crinoidea, 1914, p. 309 (same); Die Crinoiden der Antarktis, 1915, p. 181 (range; represented in the Atlantic by *Nemaster*); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk; 1 or more rays dwarfed).—F. W. Clarke and Wheeler, U. S. Geol. Survey Professional Paper 90–L, 1915, p. 195 (inorganic constitutents of the skeleton); Professional Paper 102, 1917, pp. 23 and following (same).—A. H. Clark Unstalked Crinoids of the *Siboga* Exped., 1918, p. 2 (in key); p. 9 (key to the included species).—Gislén, Nova Acta reg. Soc. sci.

Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 56 (discussion); Zool. Bidrag från Uppsala, vol. 9, 1924, p. 15 (multibrachiate condition of the very young); pp. 35, 36, 38 (brachial homologies); p. 42 (brachials); p. 74 (syzygies); p. 89 (articulations); p. 97 (pinnule articulations).

Diagnosis.—A genus of Capillasterinae in which the arms are more than 10 in number, the IIBr series are 4 (3+4) and the IIIBr series are 3 (2+3), both being subject to occasional variation and irregularity, the first pinnule of the undivided arms arising from a IIBr or later axillary is on the first brachial, there is a syzygy between brachials 2+3, except on arms arising from a IBr axillary where the first syzygy is between brachials 3+4, and the brachials beyond the basal are oblong or wedge-shaped, much broader than long.

Geographical range.—From Madagascar, Mauritius, the Maldive Islands, and Ceylon to Shark Bay, Western Australia and Cape Flattery (lat. 15° S.), Queensland, the Caroline Islands, southwestern Japan, the Philippines, and Formosa (Taiwan).

Bathymetrical range.—From the shore line down to 292 meters.

Remarks.—The species of this genus show among themselves considerably more diversity than do the species of *Comatella.* In one (*macrobrachius*) the centrodorsal is reduced to a pentagonal or stellate plate which lies within the radial pentagon and is wholly without cirri. This in the only instance of this condition in the subfamily Capillasterinae, although it is common in the Comactiniinae and Comasterinae. In another species (*asterias*) the cirri are very few in number, long, and taper to a fine point; the distal segments are only slightly, if at all, shorter than the longest proximal, and are almost or quite without dorsal processes. This form of cirrus is otherwise unknown in the entire family Comasteridae. It is very rare in the Oligophreata, where it occurs only in *Eudiocrinus junceus* (Eudiocrinidae) and in *Craspedometra acuticirra* and *Homalometra denticulata* (Himerometridae). But it is common in the families Antedonidae, Atelecrinidae, and Pentametrocrinidae in the Macrophreata. In 2 other species (*gracilicirra* and *tenuicirra*) the cirrus segments are much elongated, though the relation between the basal, proximal, and distal segments remains unchanged. The number of cirrus segments varies from 15 to 40, but is rarely over 30.

The arms vary in number from 11 or 12 to 85, but in most cases are about 20. In fully grown individuals of the various species the arm number is rather constant within fairly narrow limits. In contrast to *Comatella,* irregularities in the division series are common; indeed, in certain individuals of *multiradiata* and of *mariae* most of the division series are abnormal. A few specimens of *multiradiata* have been described which combine in a most curious way the characters of *Capillaster* and of *Comatella.*

Terminal combs are found on a variable number of the proximal pinnules, but rarely beyond P_4. But in one specimen of *multiradiata* pinnules occurred at intervals as far as P_{11}.

The disk usually bears a greater or lesser number of conspicuous granules in the anal area, and especially on and about the anal tube; but it may be naked. The mouth is usually marginal or submarginal, and the anal tube central or subcentral. But in the smaller species the mouth is often subcentral or even quite central and the anal tube more or less marginal.

KEY TO THE SPECIES IN THE GENUS CAPILLASTER

a^1. Cirri absent; centrodorsal reduced to a small stellate plate lying within the radial circlet (China Sea to the Borneo Bank; 0–59 meters) ---------------------------- **macrobrachius**, p. 158.

a^2. Cirri present.

  b^1. Cirri few, not more than X, in the distal half tapering to a fine tip, composed of elongated segments of which the terminal are only very slightly, if at all, shorter than the longest proximal, and, except for a minute opposing spine, show no trace of dorsal processes (Sunda Straits; 35 meters) -- **asterias**, p. 160.

  b^2. Cirri more than X, not tapering distally; distal cirrus segments much shorter than the longest proximal and always with conspicuous dorsal processes.

    c^1. Arms more than 40 (usually more than 60) in number; longest cirri with 30 or more (30–40, usually about 30) segments.

      d^1. Distal cirrus segments much broader than long (Maldive Islands and Ceylon to Western Australia, the Moluccas, and the Philippines; 0–135 meters) --------- **sentosa**, p. 160.

      d^2. Distal cirrus segments about as long as broad (Java Sea; 88 meters) - **gracilicirra**, p. 169.

    c^2. Seldom more than 35 (usually 15–30) arms; longest cirri with not more than 30, and seldom more than 26, segments.

      d^1. Outer cirrus segments slightly longer than broad (Java Sea and the coast of Ceram; 82–118 meters) -- **tenuicirra**, p. 209.

      d^2. Outer cirrus segments broader than long.

        e^1. Size large (arm length 160 mm.); division series perfectly smooth; entire animal mottled with whitish; disk without calcareous concretions (southwestern Japan; 0–108 meters) -- **mariae**, p. 170.

        e^2. Size medium (arm length very rarely over 125 mm. and never so much as 150 mm.); ossicles of the division series usually with finely spinous distal edges, so that the division series appear rough; no whitish mottling; disk usually with calcareous nodules more or less developed.

          f^1. Larger, stouter and more robust; usually 15–25 arms; IIIBr series often present; usually more than 23 cirrus segments (Maldive Islands and Ceylon to tropical Australia, the Caroline Islands, the Philippines and Formosa; 0–292 meters). **multiradiata**, p. 173.

          f^2. Small, slender and weak, with 12–19 arms; IIIBr series never present; 21–23 cirrus segments (Madagascar and Mauritius) ------------------ **coccodistoma**, p. 212.

CAPILLASTER MACROBRACHIUS (Hartlaub)

Plate 8, Figures 25, 26

Actinometra macrobrachius (Lütken, MS.) Hartlaub, Nachr. Ges. Göttingen, May, 1890, p. 186 (description; China Sea); Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 101 (detailed description and comparisons; China Sea).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Vidensk. Medd. fra den naturh. Forening i København, 1909, p. 117 (identity); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (identity); Crinoids of the Indian Ocean, 1912, p. 37 (identity).

Actinometra monobrachius Minchin, Zool. Record for Echinod., 1891, 1892, p. 80 (editorial error).

Comaster macrobrachius A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia macrobrachius A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Capillaster macrobrachius A. H. Clark, Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (identity); p. 4 (China Sea; description of the type); Crinoids of the Indian Ocean, 1912, p. 37 (identity); p. 73 (synonymy; record; resemblance to *Comantheria briareus*); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 9 (in key; range); p. 10 (references; detailed account; station 77); p. 272 (listed); pl. 11, figs. 4, 5.

Diagnostic features.—The entire absence of cirri and the reduction of the centrodorsal to a small stellate plate lying within the radial circlet separate this species sharply from its relatives. The only other species with which it is likely to be confused are *Comanthus timorensis* and *Comantheria briareus.*

Description.—The centrodorsal is small, flat, pentagonal, scarcely at all raised above the surface of the radials from which it is separated by narrow subradial clefts.

There are no cirri.

The radials are entirely visible. The IBr_1 are united laterally, and are moderately short and broad. The IBr_2 (axillaries) are short, pentagonal, with a sharp distal angle, and are entirely free laterally. In the type specimen the rays usually divide three times, but in one case there are four divisions. The IIBr series are 4 (3+4), and the following series are 3 (2+3).

The type specimen has 42 arms which are about 170 mm. in length. The brachials are rather short; the first is rather narrow, the following gradually increasing in width to about the twelfth, thence slowly decreasing distally. From the sixth onward the brachials are wedge-shaped, after the basal third of the arms becoming shorter wedge-shaped, and soon discoidal. The anterior and posterior arms are of equal length. The dorsal surface of the arms is only moderately rough.

The first syzygy is between brachials 1+2, and the second is from between brachials 21+22 to between brachials 26+27; beyond the second syzygy the intersyzygial interval is usually from 8 to 11 muscular articulations.

P_D is 16 mm. long, slender, with a short and poorly developed comb. The pinnules on the succeeding division series are markedly smaller, and only 10 mm. long. P_1 is from 8 to 9 mm. long, and is very much more slender than the preceding pinnules. P_a is 5 mm. long. Following P_1 and P_a there are a few pairs of pinnules of similar size, and those succeeding become only slightly longer, remaining of the same delicate structure.

The disk is naked, 16 mm. in diameter. The mouth is radial.

In alcohol the color is light yellowish brown, with the disk grayish brown.

Notes.—The specimen secured by the *Siboga* at station 77 is much smaller than the type. It has about 25 arms which are about 70 mm. long. Of the six IIBr series present, three are 2 and three are 4 (3+4). The IIIBr series are all 3 (2+3), except for one following a IIBr 2 series, which is 4 (3+4).

The centrodorsal, though stellate in shape, has not as yet quite sunk to the level of the radials; it bears a few small pits, the remnants of cirrus sockets, on its margin.

The color in alcohol is yellowish white, the pinnules being yellow green.

Except for the smaller size and the slightly less developed centrodorsal this specimen agrees well with the type with which it was directly compared.

In appearance this species bears a very close resemblance to *Comantheria briareus* and its allies.

Localities.—China Sea [Hartlaub, 1890, 1891; A. H. Clark, 1912] (1, H. M.). Pl. 8, fig. 25.

Siboga station 77; Borneo Bank (lat. 3° 27′ S., long. 117° 36′ E.); 59 meters; fine gray coral sand; June 10, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.). Pl. 8, fig. 26.

Remarks.—As yet only two specimens of this curious species have come to light.

CAPILLASTER ASTERIAS, sp. nov.

Plate 13, Figure 33; Plate 82, Figure 224

Diagnostic features.—This new form differs from all the other species of the genus in having the cirri long, in the distal half tapering to a fine tip, and composed of elongated segments of which the terminal are only very slightly, if at all, shorter than the longest proximal and bear no trace of dorsal processes. The large size, unusual smoothness, and stout arms seem to be characteristic features.

Description.—The centrodorsal is very small, thin, pentagonal, 3.5 mm. in diameter.

The cirri are VII, 31, from 30 to 35 mm. in length, very long and slender. The first segment is very short and those following increase in length to the fifth, which is about as long as broad or slightly longer than broad, and still further increase to the seventh or eighth which, with those following, is about twice as long as broad. After about the sixteenth to the twentieth segments the cirri acquire a whitish and highly polished surface, and taper slowly to the tip. There are no dorsal processes. The opposing spine is a minute median tubercle. The terminal claw is much longer than the penultimate segment, slender, and only slightly curved.

There are in the type specimen 19 rather stout arms which are about 180 mm. long. The 7 IIBr series are all 4 (3+4). The 2 IIBr series, both on the same IIBr series, are 3 (2+3). The division series are smooth. The brachials are short, very obliquely wedge-shaped, about three times as broad as the maximum length, with the distal edge very minutely spinous, though not produced.

Notes.—A similar specimen has about 15 arms; the cirri are V, all broken. A small specimen has 10 arms about 40 mm. long; the cirri are X, 21, 15 mm. long.

Locality.—Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 82; Sunda Strait (lat. 6° 38′ S., long. 105° 21′ E.); 35 meters; sandy mud; July 30, 1922 (3). Pl. 13, fig. 33; pl. 82, fig. 224.

Remarks.—The reduction in the number of cirri and of the centrodorsal as well as the general appearance suggest that the closest relationship of this species is with *C. macrobrachius.*

CAPILLASTER SENTOSA (P. H. Carpenter)

Plate 9, Figure 28; Plate 10, Figure 29; Plate 11, Figure 31

[See also vol. 1, pt. 2, figs. 5, 6 (centrodorsal and radials), p. 6; figs. 158, 159 (analysis of arm division), p. 83; fig. 180 (dorsal view), p. 92; fig. 258 (arm), p. 205; figs. 374–377 (pinnule tips), p. 243; figs. 610–612 (comb), p. 317; fig. 685 (disk), p. 341; pl. 10, fig. 1026 (analysis of arm structure); pl. 12, fig. 1031 (arm); pl. 13, fig. 1051 (oral pinnule); pl. 15, fig. 1069 (pinnule); pl. 52, fig. 1341 (ventral view, with *Ophiomaza*)]

Comatula multiradiata (part) Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 533 (redescription; includes *sentosa*, *Comanthus bennetti*, and *Comaster multifida*, but not *multiradiata* of Linné).—de Blainville, Dict. des sci. nat., vol. 10, 1818, p. 108 (from Lamarck).—Lamouroux, Encyclop. méthodique, vol. 2, 1824, p. 205 (from Lamarck).—de Blainville, Dict. des sci. nat., vol. 60, 1830, p. 229 (from Lamarck).—Oken, Allgem. Naturgesch., vol. 5, Abt. 2, 1835, p. 594 (from previous authors).—de Blainville, Manuel d'Actinologie, 1834, 1836, p. 249 (from Lamarck).—Lamarck, Hist. nat. des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 470 (from previous edition).—Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 209 (from previous edition).— J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 180 (structure).—[Gervais], Dict. universel d'hist. nat., vol. 4, 1844, p. 130 (from Lamarck).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 12 (Müller's description of the course of the ambulacral grooves).—A. H. Clark, Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 246 (identity).

Comatula (*Alecto*) *multiradiata* (part) J. Müller, Archiv f. Naturgesch., 1843, vol. 1, p. 133 (from Lamarck); Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 261 (Moluccas; description mainly; Péron's specimen).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (of J Müller, 1849=*Capillaster multiradiata* [error]).

Comatula multifida (part) J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 262 (specimen with 40 arms).—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 207 (specimen with 50 arms).

Alecto multiradiata Troschel and Ruthe, Handb. d. Zool., 1859, p. 584 (from Müller).

Actinometra multiradiata (part) P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 386; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, pp. 13, 27; Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 521 (Moluccas; Banda); p. 523 (Banda); Proc. Zool. Soc. London, 1882, 1883, p. 747 (listed); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 324 (Péron's specimen in part; but not the specimen from the locality given).

Actinometra sentosa P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 325 (description; Banda; Moluccas); pl. 66, figs. 4–6.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 102 (comparison of arms with those of *macrobrachius*).—Koehler, Mém. soc. zool. France, vol. 8, 1895, p. 421 (Sunda Is.; Biliton; notes).—Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 225 (north Male, 25 and 27 fathoms).—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, pp. 230 and following (regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (chosen as type of *Capillaster*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 503 (type of *Capillaster*); Crinoids of the Indian Ocean, 1912, pp. 35, 40 (identity of previous records).

Comaster sentosa A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 35, 1908, pp. 120, 123 (arm structure); p. 124 (listed); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 201 (*Albatross* stations 5139, 5141, 5146, 5147); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 391 (*Albatross* station 5249).

Capillaster sentosa A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 133 (Singapore; description of specimen); p. 193 (collected by Svend Gad at Singapore); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 530 (*Albatross* stations 5355, 5481, 5482, 5483); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (*Comatula multiradiata* of Lamarck is this species+*Comaster multifida*+*Comanthus bennetti*); p. 246 (Moluccas, Péron and Lesueur; Moluccas, Quoy and Gaimard; descriptions of both); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (compared with *C. gracilicirra*); Records of the Indian Mus., vol. 7, pt. 3, 1912, No. 26, p. 267 (8° 51′ 30″ N., 81° 11′ 52″ E., 28 fathoms); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 4 (Cebu; description); Crinoids of the Indian Ocean, 1912, pp. 2, 29 (included in *Comatula multiradiata* Lamarck); p. 35 (=*Actinometra sentosa* P. H. Carpenter); p. 40 (=*Actinometra sentosa* Bell, 1902); p. 73 (synonymy in detail; localities; summary of previous records; superficially resembles *Comatella nigra* more than it does the other species of *Capillaster*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 4 (published references to specimens in the B. M.; Banda, *Challenger;* North Male, Maldives); Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (collected by the *Endeavour* in Western Australia); p. 115 (an East Indian species new to Australia); p. 116 (between Fremantle and Geraldton; characters of the specimens and of the species; range); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., pp. 222 and following (detailed account of the distribution in Australia).—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 92 (occurs at Ceylon).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 10 (in key; range); p. 11 (synonymy; detailed account; stations 79, 240, 299); pp. 272, 274, 275 (listed).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 41 (details of arms); p. 44 (reversion); p. 53 (axillary angle); p. 76 (syzygies); p. 89 (articulation in the IBr series); p. 117 (relation to fossils); fig. 141, p. 95 (pinnule articulation).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, May 3, 1929, p. 636 (off Cape Padaran).

Diagnostic features.—The size is large, and the cirri are large, stout, and numerous with 26–40 segments, of which the distal are much broader than long. There are 40–110 (usually over 60) arms. This species is more easily confused with *Comatella nigra* than it is with any other species of *Capillaster.*

Description—The centrodorsal is thick discoidal or almost columnar, with the bare polar area moderate in size, from 3 to 5 mm. in diameter, usually more or less strongly concave, rarely flat or somewhat convex. The cirrus sockets are arranged in 2 or 3 closely crowded more or less irregular alternating marginal rows.

The cirri are XVI–XXX (most commonly XX–XXV), 30–40 (usually nearer the former), from 30 to 40 mm. long. The first segment is very short, and the following slowly increase in length to the sixth (more rarely the seventh or eighth) which is about as long as broad; the next 4 or 5 segments are subequal, all slightly longer than broad (usually about one-third longer than broad), and those following decrease in length, soon becoming about twice as broad as long, or even shorter, and remaining of these proportions until the end of the cirrus. A more or less, usually fairly well, differentiated transition segment occurs at about the tenth or eleventh, proximal to which the segments are dorsally rounded without dorsal processes, with a dull surface and comparatively dark in color, while distally they are light in color, highly polished, and with distal projections on the dorsal side. The tenth and following segments have the distal dorsal edge produced forming a coarsely dentate transverse ridge, usually with 5–7 distinct teeth, though these may be more or less obsolete. In lateral view this ridge appears as a small or moderate terminal or subterminal dorsal spine which may be single or bi- or tri-cuspid.

Distally this ridge becomes progressively narrower, on the outermost 12 or 13 segments being represented merely by paired dorsal spines or, more rarely, by single spines. The opposing spine is always single, median, submedian or terminal, erect, or directed slightly distally, stout, and short, rarely reaching more than one-third the width of the penultimate segment in height. The terminal claw is from half again to twice as long as the penultimate segment, stout, abruptly curved basally but becoming nearly straight distally.

The ends of the basal rays are very prominent in the interradial angles of the calyx, bridging over the narrow clefts between the radials and the centrodorsal and causing the proximal surface of the centrodorsal to assume a peculiarly stellate outline.

The radials are short and oblong, usually about half as long as, though sometimes fully as long as, the IBr_1. The IBr_1 are oblong, short, four or five times as broad as long or even broader, united interiorly for almost their entire length. The IBr_2 (axillaries) are broadly pentagonal, almost triangular, about two and one-half times as broad as long, with their sides rounded and well separated from those of their neighbors; the lateral edges are slightly shorter than those of the IBr_1. The IIBr series are 4 (3+4), rounded dorsally and laterally and well separated. The IIIBr series, IVBr series, and VBr series are 3 (2+3). There is a tendency to develop one more division series on the inner side of the IIBr and IIIBr series than on the outer.

Arms 40–85 (rarely under 60) in number, from 80 to 130 mm. long. The first brachials are wedge-shaped, about twice as broad as the interior length, almost entirely united interiorly. The first syzygial pair (composed of brachials 2+3) is oblong, nearly twice as broad as long. The next 4 brachials are oblong, three times as broad as long, usually somewhat tubercular. The following brachials are very short, wedge-shaped, about twice as broad as the longer side, soon becoming shorter and more oblong, and in the outer half of the arm regularly oblong and very short, about four times as broad as long, increasing somewhat in length, though remaining oblong, terminally. The brachials after the sixth or seventh have prominently everted edges which are armed with numerous fine spines.

Syzygies occur between brachials 2+3, again from between brachials 16+17 to between brachials 31+32 (usually in the vicinity of the twenty-first brachial), and distally at intervals of from 5 to 9 (usually 6 or 7) muscular articulations.

The mouth is marginal or submarginal, radial or nearly so. The anal tube is central or approximately central. The disk, which is from 15 to 30 mm. in diameter, is naked or bears a few calcareous nodules.

P_D is about 30 mm. long, stout basally but rapidly becoming slender. It is composed of about 70 segments which at first are considerably broader than long but gradually become proportionately longer and after the tenth about as long as broad. The terminal comb is comparatively inconspicuous. It arises gradually and is composed of 9–11 small low rounded teeth. The following pinnules decrease rapidly in length and stoutness to P_3, which is 7 mm. long, very slender, and composed of about 30 segments. The succeeding pinnules are slightly stouter, at first of about the same length, later slowly increasing in length, so that the distal pinnules are 9 or 10 mm. long. The terminal combs usually end at about P_3, but may extend as far as P . The pinnules on the division series are somewhat carinate basally. The pinnules on the arm bases as far as the fourth pair, more rarely for one or two more pairs, have the first 2 segments strongly carinate. The distal ends of the pinnule segments are armed with prominent spines, and their dorsal surface is covered with small spines.

The color in alcohol is dark reddish brown, the cirri yellow brown; yellow; brownish white; light yellow brown; nearly white, the pinnules almost black in the basal third, bright green in the distal two-thirds; or blackish brown.

Notes.—The specimen from North Male, Maldives, is a large and well-developed individual.

The examples from *Investigator* station 152 are medium sized and small, each with about 65 arms. Those from *Investigator* station 175 are all small, as are two from east of the Terribles.

The specimens from Singapore agree with others from the Philippine Islands. One has 57 arms 95 mm. long and the cirri XX, 30, from 25 to 30 mm. long.

Another has 60 arms 100 mm. long and the cirri XVIII, 30, 30 mm. long. The color of both of these is very light brown.

A third has 60 arms 90 mm. long and the cirri XX, 30, 20 mm. long. After the tenth the cirrus segments develop prominent distal edges dorsally which form sharply serrate transverse ridges; these ridges gradually become shorter distally so that the last 12 or 13 segments bear merely a pair of prominent tubercles. The opposing spine is central, subcentral or terminal, erect or directed slightly outward, stout, and short, rarely reaching to more than one-third the lateral width of the penultimate segment in height. The terminal claw is from half again to twice as long as the penultimate segment, stout, abruptly curved basally but becoming straighter distally.

Another specimen from Singapore has about 70 arms which are about 80 mm. long, and the cirri XVI, 25 mm. long. The color is light brownish with the distal two-thirds of the cirri lighter.

A typical specimen from Singapore has about 100 arms 95 mm. long.

A small specimen from Singapore has 35 arms 80 mm. long. The anal area, which occupies most of the disk, is rather thickly set with small concretions most of which are rounded with a depressed center, though some are U-shaped, and some are confluent with those adjacent. This individual is practically intermediate between *sentosa* and *multiradiata*.

One of the samples from Singapore with about 75 arms 100 mm. in length and the disk 15 mm. in diameter has a large *Ophiomaza* lying on the disk.

One of the other specimens from Singapore has about 70 arms.

Worthy of note is still another which is nearly white with the pinnules nearly black in the basal third and bright green in the distal two-thirds.

One of the specimens from Sebesi Strait is large, with 80 arms. The other has 50 arms; of the 10 IIBr series 7 are 4 (3+4), 1 is 3 (2+3), 1 is 2, and 1 is 8 (3+4, 7+8).

The example from north of western Java is typical, with 61 arms.

The specimen from Billiton recorded by Professor Koehler has 56 arms. There are 25–32 cirrus segments. The radials are clearly visible. The distal edges of the elements of the division series and the first 2 or 3 brachials are not furnished with spines; these do not appear until beyond the third or fourth brachials.

The specimen from *Siboga* station 299 (Rotti) has 56 arms 110 mm. long; the cirri have 29–30 segments and are from 25 to 30 mm. long.

Dr. P. H. Carpenter's description of this species was based on the two specimens collected by the *Challenger* at Banda and one from the Moluccas collected by Quoy and Gaimard. As noted by him the centrodorsal is a thick disk, sometimes almost columnar, with the dorsal pole partially excavated. The cirri are XX–XXX, 26–40, with the fifth segment usually longer than broad and the next 2 or 3 the longest, least markedly so in the older cirri. The later segments are about as long as broad and somewhat compressed laterally, small spines appearing near their distal edges which increase in distinctness up to the penultimate.

The radials are visible, least so in the larger specimens. The IBr_1 are partly united laterally. The division series are well separated from each other. The IIBr series are 4 (3+4), and the IIIBr and following series are 3 (2+3).

The arms are 40–65 in number 125 mm. long and are composed of 120–150 brachials, of which the first few are nearly oblong and those following are short triangular with overlapping and coarsely spinous distal edges. From about the fortieth onward, as the arms narrow, the segments become more oblong and the terminal brachials are nearly as long as broad. The anterior arms may be slightly longer than the posterior.

Syzygies occur between brachials 2+3, again from between brachials 16+17 to between brachials 31+32, and distally at intervals of from 5 to 9 (usually 6 or 7) muscular articulations.

P_D is nearly 30 mm. long, moderately stout at the base but soon becoming more slender. The length of the succeeding pinnules decreases to about P_5, which is not especially small, and slowly increases distally. The lowest pinnules have a large terminal comb involving 12–15 segments which may extend as far as P_{14}. The edges of the pinnule segments are fringed with spines.

The mouth is radial, or nearly so, and the disk is naked or bears a few calcareous nodules.

The specimen from *Siboga* station 240 (Banda) is small with 17 arms and is undergoing adolescent autotomy. The left posterior and left anterior rays are in process of multiple division; the former has one IIBr 4 (3+4) series which bears internally a IIIBr 3 (2+3) series carrying two IVBr 3 (2+3) series; the latter has one IIBr 4 (3+4) series which bears a IIIBr 3 (2+3) series externally and a IIIBr 4 (3+4) series internally, the former carrying on the left (innermost) side a IVBr 3 (2+3) series. The specimen is slender and delicate.

Of the two specimens collected by the *Endeavour* between Fremantle and Geraldton, Western Australia, one is small, but typical, with 73 arms. One of the IIBr series is 2, the remaining 9 being 4 (3+4). The following division series are all 3 (2+3).

The other specimen has 33 arms 115 mm. long. There are 9 IIBr series, all 4 (3+4), and 13 IIIBr series, all 3 (2+3). The centrodorsal is typically large and hemispherical. The cirri are composed of 28–30 segments and are from 27 to 30 mm. in length.

The specimen from Amboina is typical with about 70 arms 140 mm. long. Of the 10 IIBr series, 6 are 4 (3+4) and 4 are 2.

The example from the Danish expedition to the Kei Islands station 14 is small with 58 arms and is just beginning to acquire the adult characters. Of the 3 specimens from station 26, one is typical with about 70 arms which are about 105 mm. long; two of the IIBr series are 2; the cirri are XVI, 32–35, from 30 to 35 mm. long. A similar specimen has one of the IIBr series 2. The third specimen is small with 12 arms, both of the IIBr series being 4 (3+4).

The specimen from the Moluccas collected by Péron and Lesueur, which I examined in Paris, has apparently exactly 40 arms; the cirri have 29–34 segments. Carpenter remarked (1882) that in this specimen there is a tolerably well-marked median tubercle at the junction of the IBr_1 and IBr_2, while the intersyzygial interval appears to be 11–14 muscular articulations.

Quoy and Gaimard's specimen from the Moluccas has about 50 arms, and the cirri have 27–30 segments. Carpenter noticed (1882) that in this individual the pinnules on the IIBr and IIIBr series have a slight keel on the second and third segments, traces of which sometimes extend outward along the arms as far as the seventh brachial. This does not occur in the two *Challenger* specimens from Banda.

The specimen from *Siboga* station 79 has about 80 arms which are 130 mm. in length. The cirri are 35 mm. long with 37–38 segments.

The specimen from Cebu is large with the brachials and the elements of the outer division series strongly everted distally.

Of the 3 specimens collected by Dr. Th. Mortensen off Jolo, that from about 22 meters has about 60 arms about 110 mm. long; on each IIBr series the arms are in

2, 1, 1, 2 order. The example from about 27 meters has 33 arms about 140 mm. long. The first one from about 36 meters has about 85 arms.

The example from *Albatross* station 5481 has 50 arms 90 mm. long, and the cirri XX, 27–35, from 25 to 30 mm. (usually 27 mm.) long.

The specimen from *Albatross* station 5482 has 41 arms 120 mm. long, and the cirri XXI, 27–30 (usually 28), from 25 to 30 mm. (usually 27 mm.) in length.

The individual from *Albatross* station 5483 has 37 arms 110 mm. long, and the cirri XXVIII, 27–31, from 25 to 30 mm. (usually 27 mm.) long.

One of the specimens from Port Galera has 67 arms which are about 160 mm. long.

Two of the specimens from Port Galera are very irregular. The arms are from 90 to 110 mm. in length. In all cases one derivative from the IBr series is undivided, while the other divides into anywhere from 4 to 8 arms.

The specimen from off Cape Padaran has 22 arms about 170 mm. long. The longest cirri have 31 segments.

Abnormal specimens.—In the specimen collected by the *Siboga* at Banda (station 240) one of the IIIBr series is 4 (3+4) instead of 3 (2+3) as usual.

In one of the specimens from Port Galera one of the IIBr series is 2, and another is 3 (2+3).

In one of the specimens from Sebesi Strait 7 of the IIBr series are 4 (3+4), 1 is 3 (2+3), 1 is 2, and 1 is 8 (3+4, 7+8).

Localities.—North Male, Maldives; 46 and 49 meters [Bell, 1902; A. H. Clark, 1913] (1, B. M.).

Investigator station 152; 11.5 miles S. 83° W. of Colombo Light House, Ceylon; 56 meters; sand, shells, and coral; December 12, 1893 [A. H. Clark, 1912; H. L. Clark, 1915] (4, U.S.N.M., 34837, 34848; I. M.).

Investigator station 175; off the northeastern coast of Ceylon (lat. 8° 51′ 30″ N., long. 81° 11′ 52″ E.); 51 meters; sand, shells, and stones; April 20, 1894 [A. H. Clark, 1912; H. L. Clark, 1915] (3, U.S.N.M., 34840; I. M.).

Investigator; east of the Terribles; 24 meters [A. H. Clark, 1912] (2, U.S.N.M., 34835, 34836).

Singapore; Svend Gad [A. H. Clark, 1909] (12, C. M.). Pl. 9, fig. 28; pl. 11, fig. 31.

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 90; Sebesi Strait, between Sumatra and Java; 36 meters; August 1, 1922 (2).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 67; Java Sea, north of the western end of Java (lat. 5° 48′ S., long. 106° 12′ E.); 38 meters; sand and shells; July 27, 1922 (1).

Billiton, Sunda Islands [Koehler, 1895].

Siboga station 299; Boeka or Cyrus Bay, southern coast of Rotti (lat. 10° 52′ 24″ S., long. 123° 01′ 06″ E.); 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger; Banda; 31 meters [P. H. Carpenter, 1882, 1888; A. H. Clark, 1913] (2, B. M.).

Siboga station 240; anchorage at Banda; 9–45 meters; black sand, coral bottom, and a lithothamnion bank; between November 22 and December 1, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Endeavour; between Fremantle and Geraldton, Western Australia [A. H. Clark, 1914] (2, W. A. Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; breakwater; about 1 meter; February 28, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 14; about 40 meters; sand; April 10, 1922 (1); station 26; about 90 meters; sand; April 16, 1922 (3).

Moluccas; Péron and Lesueur, 1803 [Lamarck, 1816; J. Müller, 1843, 1849; P. H. Carpenter, 1882, 1888; A. H. Clark, 1911] (1, P. M.).

Moluccas; Quoy and Gaimard [P. H. Carpenter, 1882, 1888; A. H. Clark, 1911] (1, P. M.).

Siboga station 79; Borneo Bank (lat. 2° 43′ S., long. 117° 44′ E.); 41–54 meters; fine coral sand; June 12, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Albatross station 5147; near Siasi, Jolo (Sulu) archipelago; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908].

Albatross station 5146; near Siasi, Jolo archipelago; Sulade Island (E.) bearing N. 18° W., 3.4 miles distant (lat. 5° 46′ 40″ N., long. 120° 48′ 50″ E.); 44 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908] (1 U.S.N.M., 34844). Pl. 10, fig. 29.

Albatross station 5137; near Jolo; Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36 meters; sand and shells; February 14, 1908 (1, U.S.N.M., 34841).

Albatross station 5139; near Jolo; Jolo Light bearing S. 51° W., 3.6 miles distant (lat. 6° 06′ 00″ N., long. 121° 02′ 30″ E.); 36 meters; coral sand; February 14, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 34839, 34849).

Albatross station 5141; near Jolo; Jolo Light bearing S. 17° E., 5.5 miles distant (lat. 6° 09′ 00″ N., long. 120° 58′ 00″ E.); 53 meters; coral sand; February 15, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 34842, 34847).

Dr. Th. Mortensen's Pacific Expedition, 1914–1916; off Jolo (Sulu); about 22 meters; March 17, 1914 (1); about 27 meters; March 21, 1914 (1); about 36 meters; March 17, 1914 (1); about 36 meters; March 21, 1914 (1).

Albatross station 5249; Gulf of Davao, Philippines; Lanang Point bearing N., 1 mile distant (lat. 7° 06′ 06″ N., long. 125° 40′ 08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34850).

Albatross station 5355; North Balabac Strait, Philippines; Balabac Light bearing S., 61° W., 16.6 miles distant (lat. 8° 08′ 10″ N., long. 117° 19′ 15″ E.); 80 meters; coral and sand; January 5, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 34846).

Cebu, Philippines [A. H. Clark, 1912] (1, H. M.).

Albatross station 5481; between Samar and Leyte, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 86° W., 3.8 miles distant (lat. 10° 27′ 30″ N., long. 125° 17′ 10″ E.); 111 meters; sand, shells, and gravel; July 30, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 34876).

Albatross station 5482; between Samar and Leyte, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 87° W., 4.5 miles distant (lat. 10° 27′ 30″ N., long. 125° 18′ 00″ E.); 122 meters; broken shells, sand, and green mud; July 30, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 34845).

Albatross station 5483; between Samar and Leyte, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 88° W., 5.7 miles distant (lat. 10° 27′ 30″ N., long. 125° 19′ 15″ E.); 135 meters; sand and broken shells; July 30, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 34838).

Port Galera, Mindoro; Dr. Laurence E. Griffin (4, M. C. Z., 655, 656).

Off Cape Padaran, southern Annam (lat. 11° 38′ N., long. 109° 41′ E.); 146 meters; from the Cape St. James-Hong Kong cable; M. H. Ellis, June 4, 1927 [A. H. Clark, 1929] (1, B. M.).

Geographical range.—From the Maldive Islands and Ceylon eastward to the Lesser Sunda Islands, Western Australia, the Moluccas, the Philippines, and southern Annam.

Bathymetrical range.—From the low-tide mark down to 135 meters; the average of 23 records is 49 meters.

History.—The first known specimen of this species was collected by Péron and Lesueur in the Moluccas in 1803. This, together with two others collected at the same time, one of which represented *Comaster multifida* and the other *Comanthus bennetti*, was examined by Lamarck, and from his study of these three he drew up his description of *Comatula multiradiata* (1816).

In 1849, J. Müller referred this specimen to the Linnean *Asterias multiradiata* as redescribed by Retzius in 1805. He himself had examined the Linnean type at Lund, and in 1843 had published a detailed description of it. In 1849 he modified this so as to include Péron and Lesueur's example. Thus he gave the number of the arms as 40 to 50 instead of 30 to 40 as given by Retzius, and the number of cirrus segments as 20–30 instead of 24.

He had long been aware that Lamarck's *Comatula multiradiata* was a composite, for in 1841 he had redescribed it, basing his redescription, published under the name *Alecto multifida*, upon the specimen representing the species now known as *Comaster multifida*.

In 1862 Dujardin and Hupé used the name *Comatula multifida* to cover all of the specimens which had been studied by Lamarck. Under the name *Actinometra multiradiata* they reprinted Müller's redescription of the specimen (*Capillaster multiradiata*) at Lund described by Linné and by Retzius.

Dr. P. H. Carpenter in 1879 accepted Müller's reference of Péron and Lesueur's specimen to *multiradiata*.

In 1882 he published a revised description of *multiradiata* which was based upon two specimens collected by the *Challenger* at Banda. These were similar to the Moluccan specimens collected by Péron and Lesueur and by Quoy and Gaimard. He mentioned both of these and gave notes on them, having examined them at Paris. He included as conspecific with these four examples the type specimen of *multiradiata* at Lund, and another in the Hamburg Museum from Sumatra, both of which represent *multiradiata*.

In the *Challenger* report (1888) Carpenter described *sentosa* as distinct from *multiradiata*, his description being the same as that published under the name *multiradiata* in 1882 and based upon the two *Challenger* specimens from Banda. He remarked that he had only seen "three specimens of *Actinometra sentosa*, one which was brought to the Paris Museum by Quoy and Gaimard, and the two dredged at Banda by the *Challenger*." The specimen collected by Péron and Lesueur he referred to *multiradiata* and not to his new species *sentosa*. But for this specimen he erroneously gave the locality "Australian Seas" instead of the Moluccas. Péron and Lesueur's specimen from Australia was taken by J. Müller as the type specimen of Lamarck's *Comatula multiradiata* and was redescribed by him under the name of *Alecto multifida*. Evidently Carpenter confused these two examples.

Following Carpenter, all authors have accepted *sentosa* as a species distinct from *multiradiata*.

This species was recorded by Koehler in 1895 from Billiton, and by F. Jeffrey Bell in 1902 from the Maldive Islands. The present author recorded it in 1908 from *Albatross* stations 5139, 5141, 5146, and 5147, and in 1909 from station 5249, and also from Singapore.

In 1911 he published notes on the specimens from the Moluccas collected by Péron and Lesueur and by Quoy and Gaimard which he had examined in Paris in the preceding year, and recorded it from *Albatross* stations 5355, 5481, 5482, and 5483. In 1912 he recorded the specimens from the Indian Ocean which had been collected by the *Investigator*, and in 1913 he published his notes on the specimens in the British Museum examined in 1910. In 1914 he recorded it from the coast of Western Australia, and in 1918 from three localities in the Dutch East Indies where it had been collected by the *Siboga*.

Most of the records of this species have been accompanied by notes on various details of the structure, and in 1924 Gislén published additional information on the morphology.

CAPILLASTER GRACILICIRRA A. H. Clark

Plate 9, Figure 27

Capillaster gracilicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (description; *Siboga* station 320); Unstalked Crinoids of the *Siboga* Exped., 1918, p. VIII (discovery by the *Siboga* and its significance); p. 10 (in key; range); p. 11 (detailed description; stations 318, 320); p. 276 (listed); pl. 11, fig. 3.

Diagnostic features.—This species resembles *C. sentosa* except for having the distal cirrus segments about as long as broad instead of broader than long. There are 27–36 (usually nearer the latter) cirrus segments, and 33–110 arms.

Description.—The cirri are XVII, 27–36 (usually nearer the latter), from 33 to 35 mm. long. The longest proximal segments are twice as long as broad, and are slightly constricted centrally with swollen ends. The shorter distal segments are about as long as broad. The tenth or eleventh is a transition segment. The eleventh or twelfth segments have several sharp spines on the distal border; on the two or three segments following, the central spine rapidly increases in size, becoming a long subterminal dorsal spine flanked at the base by a smaller one on either side. On the outer cirrus segments there may be two dorsal spines, a proximal and a distal.

The arms are 33–110 in number, from 100 to 140 mm. in length.

Except for the characters given above this species resembles *C. sentosa*.

Notes.—One of the specimens from *Siboga* station 318 is a magnificent example of the species. It has 110 arms which are 140 mm. long. No fully developed cirri are preserved, but from the young cirri present it appears undoubtedly to be referable to this form instead of to *C. sentosa* which, except for the cirri, it exactly resembles.

The other two specimens are smaller, with 33 and 35 arms and cirri 35 mm. long composed of 28–36 segments. They seem to belong to *C. gracilicirra* rather than to *C. tenuicirra*, although as yet they have not acquired all of the characters of that form.

The smaller specimens from *Siboga* station 318 are peculiar in having on the outer cirrus segments two dorsal spines, a proximal and a distal.

The single individual from *Siboga* station 320 has been chosen as the type of the species. The cirri are XVII, 27–35 (usually nearer the latter), 33 mm. long. The longest proximal cirrus segments are twice as long as broad, and are slightly constricted centrally with swollen ends. The shorter distal segments are about as long as broad. The tenth or eleventh is a transition segment. There are 51 arms 100 mm. long.

Localities.—*Siboga* station 318; Java Sea, east of Madoera, north of the eastern end of Java (lat. 6° 36′ 30″ S., long. 114° 55′ 30″ E.); 88 meters; fine yellowish gray mud; February 22, 1900 [A. H. Clark, 1918] (3, U.S.N.M., E. 456; Amsterdam Mus.).

Siboga station 320; Java Sea, northeast of Madoera (lat. 6° 05′ 00″ S., long. 114° 07′ 00″ E.); 82 meters; fine gray mud; February 23, 1900 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.). Pl. 9, fig. 27.

Remarks.—This species is only known from the original specimens collected by the *Siboga* in 1900.

CAPILLASTER MARIAE (A. H. Clark)

Plate 12, Figure 32

[See also vol. 1, part 1, fig. 322 (cirrus), p. 277]

Actinometra multiradiata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 323 (Kagoshima Bay, Japan); p. 325 (characters).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 104 (Kagoshima; characters of the specimen).

Comatula mariae A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 153 (description; *Albatross* station 4880).

Comaster mariae A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 34, 1908, p. 317 (Japan); vol. 35, 1908, pp. 120, 123, 128 (arm structure); p. 124 (listed).

Comaster multiradiata A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 317 (Japan).

Capillaster mariae A. H. Clark, Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 4 (Hartlaub's specimen from Kagoshima referred to this form); Crinoids of the Indian Ocean, 1912, p. 74 (southern Japan; other localities refer to *multiradiata*).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 86 (comparison with *C. clarki*).—A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 10 (in key; range); p. 18 (remarks).

Capillaster multiradiata A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 74 (in part; southern Japan).

Diagnostic features.—This species resembles in general *C. multiradiata*, but it is larger, with the 26–27 arms about 160 mm. in length, with the division series perfectly smooth, and with a curiously mottled appearance. The cirri have 27–30 segments.

Description.—The centrodorsal is large, discoidal, with the bare polar area flat and circular, 9 mm. in diameter. The cirrus sockets are closely crowded and are arranged in a single or partially double marginal row.

The cirri are XXV, 27–30, 25 mm. long, and moderately stout. The first segment is very short and the following gradually increase in length to the fourth or fifth which is almost or quite twice as long as broad. The fifth or sixth is a transition segment, from half again to almost twice as long as broad. The following segment is similar, and those succeeding decrease in length so that the terminal 12 or 15 are about half again as broad as long. The transition and following segments have the distal edge produced dorsally and dorsolaterally. This production soon becomes confined to the dorsal side only, at the same time increasing in height and involving more and more of the dorsal surface of the segments, so that on the short distal segments, beginning on the fifth or sixth after the transition segment, it becomes a rather prominent dorsal spine which is carinate along the middorsal line, arises evenly from the entire dorsal surface of the segments, and has the apex distal in position and not produced. On the terminal 4 or 5 segments the apex gradually moves to a more central position and the spine at the same time becomes more and more compressed laterally so that on the antepenultimate and preceding segment it becomes an ordinary dorsal spine resembling the opposing spine, median in position, and in height equal to not quite half the width of the segment which bears it.

The opposing spine is terminal in position, its distal profile forming an obtuse angle with the oblique distal end of the penultimate segment, rather slender with a rounded apex, in height reaching to about half the distal width of the penultimate segment. The terminal claw is longer than the penultimate segment, stout and strongly curved basally but becoming more slender and slightly curved distally.

The radials are concealed by the centrodorsal. On some rays the IBr_1 are also concealed by the centrodorsal; when these are visible they are very short, oblong, and laterally united. The IBr_2 (axillaries) are short and broadly pentagonal, over twice as broad as long, rounded and free laterally. The succeeding division series are dorsally smooth and rounded, laterally free, and very irregular. Nine of the 10 IIBr series are present in the type specimen; of these 1 is 4 (3+4), 4 are 2, 1 is 2 (1+2), and 3 consist of an axillary only. Seven IIIBr series are present, of which 1 is 4 (3+4), 3 are 3 (2+3), 2 are 2 (1+2), and 1 is 2.

The arms in the type specimen are 26 in number and 160 mm. in length, rather slender, and remarkably uniform in width throughout their length. The first brachials are wedge-shaped, half again as broad as long exteriorly, rather large, and entirely united interiorly. The second and third brachials, commonly united into a syzygial pair, are oblong, about two and one-half times as broad as long. The next 5 brachials are oblong, about three times as broad as long. The following brachials are wedge-shaped, rapidly becoming triangular, twice as broad as long, after the proximal third of the arm gradually becoming wedge-shaped again, in the distal half almost oblong, about three times as broad as long, and in the terminal portion longer again, about as long as broad, though still remaining slightly wedge-shaped.

The brachials from the fifth or sixth onward have prominent and finely spinous distal ends.

The first syzygy usually occurs between brachials 2+3, but it may be between brachials 1+2 or 3+4, while on some arms syzygies occur between brachials 1+2 and 3+4. The next syzygy may be anywhere from between brachials 17+18 to between brachials 41+42, and the distal intersyzygial interval is very irregular, varying from 8 to 27 muscular articulations.

The lowest pinnule (P_D, P_P, or P_1) is 23 mm. long, rather slender, though slightly stouter than those following, and is composed of about 52 segments, of which the first 2 are about twice as broad as long and those following increase slowly in length to the ninth which, with the remainder, is about as long as broad. The terminal comb is prominent and begins rather abruptly. It is composed of 15 teeth which are rounded triangular, nearly twice as long as broad at the base, and rather strongly recurved. P_2 is 18 mm. long, similar to P_1 but slightly more slender, with the segments becoming as long as broad at about the seventh. P_3 is 10 mm. long, very nearly as stout basally as P_2 but tapering more rapidly. P_4 is 9 mm. long, and resembles P_3. P_5 is 8 mm. long and resembles P_4. P_6 is 7 mm. long and resembles P_5. P_7 and the following pinnules are stouter than the 3 or 4 preceding, but they become abruptly slender in the terminal portion and bear terminal combs. They are composed of about 22 segments, of which the first 2 are broader than long and the remainder are about as broad as long. Terminal combs occur as far out as P_{21}. After P_7 the pinnules begin to increase very slowly in length, after the proximal third of the arm also becoming gradually more slender. The distal pinnules are 12 mm. long and are composed of about 25 segments, of which the first 2 are about twice as broad as long and the third and following are about half again as long as broad with prominent articulations. The distal ends of the segments of all the pinnules except the first 4 or 5 are everted and spinous and the dorsal surface of the segments of the middle and distal pinnules is finely spinous, especially in their outer portions.

The whole surface of the animal is covered with a finely reticulated membrane like fine white netting which only opens along the ambulacral grooves along the edges of which it forms a band from which a row of small scallops project outward appearing like covering plates. This organic network completely hides the articulations of the brachials and pinnulars unless it is contracted by drying. It is especially thick at the articulations of the pinnule segments causing them to stand out white against the darker general surface of the segments and giving the pinnules a characteristic finely banded appearance like those of *Nemaster discoidea.*

The color in alcohol is brownish yellow with a somewhat grayish cast, the pinnules very finely banded brown and white.

Notes.—Dr. P. H. Carpenter examined two very fine specimens from Kagoshima Bay, Japan, which had been dredged by Dr. Ludwig Döderlein. He wrote that, apart from their large size and somewhat smoother arms than usual, they are also remarkable for the peculiar mottled appearance of the disk, which is naked and without the calcareous concretions that occur in specimens of *multiradiata* from further south, and the type specimen of that species.

The specimen from Kagoshima in the Stuttgart Museum recorded by Dr. Clemens Hartlaub has 27 arms. He remarked that it is markedly larger than specimens of *multiradiata* which he had examined (from the China Sea, Taiwan [Formosa] and Amboina), and otherwise differs in many respects. Of the 9 IIBr series present, 4 are 2 instead of the usual 4 (3+4). The outer syzygial pairs of the 4 (3+4) series are remarkably small in comparison with the two preceding segments. The articulations of the division series are smooth, whereas in the Chinese specimens of *multiradiata* they are as uneven as those of the brachials. The distal edges of the brachials are not so strongly produced as usual, and are also less strongly spinous than in specimens of *multiradiata*.

Localities.—Kagoshima Bay, Japan [P. H. Carpenter, 1888; Hartlaub, 1891].

Albatross station 4880; in the eastern channel of the Korean Straits, near the Oki Islands; Oki Shima bearing S. 79° W., 7.5 miles distant (lat. 34° 16′ 00″ N., long. 130° 16′ 00″ E.); 108 meters; fine gray sand and broken shells; August 2, 1906 [A. H. Clark, 1907, 1912, 1918] (1, U.S.N.M., 22655). Pl. 12, fig. 32.

Remarks.—This species is only known from four specimens, all from southwestern Japan. Of these I have only seen one, Hartlaub has seen one, and Carpenter has seen two.

CAPILLASTER MULTIRADIATA (Linné)

Plate 3, Figure 5; Plate 11, Figure 30; Plate 13, Figure 34; Plate 14, Figures 35, 36; Plate 81, Figures 222, 223

[See also vol. 1, part 1, fig. 52 (pinnule tip), p. 81; fig. 323 (cirrus), p. 277; pt. 2, figs. 7, 8 (centrodorsal and radials), p. 6; fig. 181 (dorsal view), p. 94; fig. 261 (arm), p. 205; figs. 378, 379 (pinnule tip), p. 243; figs. 613–615 (comb), p. 317; pl. 9, fig. 1022 (analysis of arm division); pl. 12, fig. 1032 (arm) and fig. 1043 (oral pinnule); pl. 15, fig. 1068 (pinnule); pl. 23, figs. 1147, 1148 (disk)]

Double ray'd China Sea Star Petiver, Mus. Petiveriam, 1695, p. 85.

Stella chinensis perelegans Petiver, Gazophylacium Naturae et Artis, 1711; Aquatilium animalium Amboinensium Icones et Nomina, 1713; Gazophylacium, 1716, pl. 4, fig. 6.—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 2 (history).

Τρισκαιδεκάκνημος Linck, De Stellis marinis, 1733, p. 53 (based on Petiver).

Triscaedecacnemos Schulze, Betrachtung d. versteinerten Seesterne, 1763, p. 53 (from Linck, after Petiver).—Bather, Ann. and Mag. Nat. Hist., ser. 8, vol. 4, 1909, p. 39 (history).—Springer, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 183 (history).

Asterias pectinata (part) Linné, Syst. Nat., ed. 10, vol. 1, 1758, p. 663 (reference to Petiver); ed. 12, vol. 1, 1767, p. 1101 (same).—P. L. S. Müller, Linné's Natursystem, vol. 6, 1775, p. 140 (from Linné).

Asterias multiradiata Linné, Syst. Nat., ed. 10, vol. 1, 1758, p. 663 (Indian Seas; type specimen at Lund, but none of the references cited); ed. 12, vol. 1, 1767, p. 1101 (same).—A. J. Retzius, K. svensk. Vetensk. Akad. Handl., År 1783, vol. 4, p. 241 (redescription of the Linnean type specimen).—Gmelin, Syst. Nat., ed. 13, vol. 1, 1788, pt. 6, p. 3166 (from Linné).—Latham and Davis, Faunula Indica, 1795, p. 32 (from Linné).—Gebauer, System Verzeichniss d. Seesterne, Seeigel, etc., 1802, p. iv (from Linné).—Bosc, Hist. nat. des vers, vol. 2, An X (1802), p. 114 (from Linné).—A. J. Retzius, Dissertatio sistens species cognitas asteriarum, Lund, 1805, p. 35 (redescription).—Cuvier, Le règne animal, vol. 4, 1817, p. 12 (from Linné); Le règne animal, nouv. ed., vol. 3, 1830, p. 229 (from the previous edition).—Latreille, Cuvier's Animal Kingdom, vol. 4, 1831, p. 334 (from Cuvier).—Griffith, Cuvier's Animal Kingdom, 1835, p. cx (from Cuvier).—J. Müller, Archiv f. Naturgesch., 1843, vol. 1, p. 133 (redescribed from the type); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 218 (structure).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 3 (identity); p. 11 (Retzius' specimen redescribed by Müller).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 392 (includes *Comatula fimbriata*, *Actinometra borneensis*, and *Actinometra coppingeri*).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, pp. 710, 711 (history); Crinoids of the Indian Ocean, 1912, p. 1 (history); p. 2 (none of the components are identifiable, but the type specimen represents *Capillaster multiradiata*).

Asterias (*Ophiura*) *multiradiata* Oken, Lehrb. d. Naturgesch., 3 Thiel, 1815, p. 356 (from previous authors).

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Comatula (*Alecto*) *multiradiata* J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 261 (in part).

Alecto fimbriata J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 185 (after Lamarck); Archiv f. Naturgesch., 1841, vol. 1, p. 144 (same); Archiv f. Naturgesch., 1843, vol. 1, p. 136 (redescribed).

Comatula (*Alecto*) *fimbriata* J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 258 (redescribed; Trinquemale).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 74 (identity).

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Actinometra gracilis LÜTKEN, Mus. Godeffroy Cat., vol. 5, 1874, p. 190 (Formosa).— HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 103 (Formosa; characters).—A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (synonym of *Capillaster multiradiata*).

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Comaster borneensis A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 35, 1908, pp. 120, 123 (arm structure); p. 124 (listed).

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Comaster fimbriata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 35, 1908, pp. 120, 123 (arm structure); p. 124 (listed); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 201 (*Albatross* stations 5136, 5137, 5138, 5139, 5141, 5142, 5147, 5163, 5165, 5205; also Philippine Is. with no further data).

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Capillaster multiradiata A. H. Clark, Zool. Anzeiger, vol. 34, Nos. 11–12, 1909, p. 364 (Dirk Hartog I., 7 fathoms; *fimbriata*, *borneensis*, and *coppingeri* considered as synonyms); A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 123 (range); p. 134 (synonymy; localities; descriptions of specimens); p. 193 (collected at Singapore by Svend Gad); p. 195 (host of *Eulima capillastericola*).—Bartsch, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 195 (Singapore; description of *Eulima capillastericola*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 530 (*Albatross* stations 5249, 5276, 5355, 5482; description of an abnormal specimen); vol. 40, 1911, p. 13 (occurs at Ceylon, but not in the Arabian Sea); p. 16 (synonymy; record of a typical specimen from the Sunda Straits); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (includes *fimbriata* Lamarck); p. 246 (Sunda Straits); p. 248 (*Asterias multiradiata* Linné); Notes from the Leyden Mus., vol. 33, 1911, p. 177 (Java Sea); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 437 (northwest Australia); p. 439 (East Indian species occurring south to Dirk Hartog and Flinders Is.); p. 443 (range on the east coast); p. 444 (range on the west coast); p. 445 (summary of west Australian records); Memoirs Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia); p. 721 (occurs south to Flinders I.); p. 722 (northwest Australia); p. 724 (Turtle Bay, Dirk Hartog I.); p. 736 (annotated synonymy; characters; summary of Australian records; range); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (compared with *C. tenuicirra*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 4 (specimens in the Hamburg Mus.); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (specimens in the Berlin Mus.); Crinoids of the Indian Ocean, 1912, pp. 1, 30, 31, 35, 37, 38, 39, 40 (identity of previous records); p. 74 (detailed synonymy; localities; descriptions of specimens; discussion); p. 123 (*Eulima capil-*

lastericola parasitic on this species); p. 310 (additional localities; description of a very abnormal specimen).—Koehler and Vaney, Bull. scient. de la France et de la Belgique, ser. 7, vol. 46, fasc. 3, 1912, p. 206 (gastropod parasite).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 5 (specimens in the British Museum).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 83 (Ceylon); p. 84 (Ceylon; characters of the 4 specimens).—Vaney, Bull. scient. de la France et de la Belgique, ser. 7, vol. 47, fasc. 1, 1913, p. 17 (history and affinities of the gastropod parasite).—A. H. Clark, Records of the Western Australian Mus., vol. 1, part 3, 1914, p. 114 (collected by the *Endeavour* in Western Australia); p. 115 (East Indian species; range extended southward from Dirk Hartog I.); p. 117 (between Fremantle and Geraldton; characters of the specimens).—F. W. Clarke and Wheeler, U. S. Geological Survey Professional Paper 90-D, 1914, pp. 33 and following (inorganic constituents of the skeleton).—A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of the distribution in Australia).—H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 101 (Mer; 5–6 fathoms; color in life; characters); Spolia Zeylanica, vol. 10, part 37, 1915, p. 92 (occurs at Ceylon).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 233 (Dirk Hartog I., No. 3432; St. Mathias I., No. 5941; British North Borneo, No. 6373).—F. W. Clarke and Wheeler, U. S. Geological Survey Professional Paper 102, 1917, pp. 20 and following (inorganic constituents of the skeleton).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 10 (in key; range); p. 14 (synonymy; notes; stations 33, 37, 40, 47, 49*a*, 50, 60, 90, 93, 99, 133, 144, 162, 240, 250, 282, 285, 294, 296, 299); pp. 271–275 (listed); pl. 3 (colored); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 16 (pinnule tip); pl. 3, fig. 37 (cirrus).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 8 (collected by the Carnegie Exped., 1913); p. 14 (Mer; notes; Port Galera, Philippines; color in life); pp. 192 and following (range).

?*Actinometra fimbriata* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 281, 414 (listed); p. 479 (Sooloo Is.).

Capillaster mariae A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 74 (Andaman Is.; Ruk, Carolines).

Capillaster clarki Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 82 (Aru Is.); p. 85 (Aru Is.; localities; detailed description); figs. 2–5, p. 86 (showing irregular division series, irregular distribution of the syzygies, and a cirrus).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 10 (in key; range); p. 18 (discussion; considered as a synonym of *C. multiradiata*).

Comaster multifida (part) Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 3 (listed); p. 5 (Mjöberg's station 1); p. 14 (station 1; notes); pl. 1, fig. 4.

Comanthus (*Vania*) *parvicirra* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 50 (*Comaster multifida* described in 1919 in synonymy).

Diagnostic features.—This is a medium-sized species with usually 15–25 arms and 15–28 (usually 20–24) cirrus segments, of which the outermost 12–14 are about half again as broad as long.

Description.—The centrodorsal is moderate in size, discoidal, with the polar area flat or slightly concave, usually with a shallow median pit, about 4 mm. in diameter. The cirrus sockets are arranged in a crowded and somewhat irregular marginal row, usually with a more or less complete second row of sockets which alternate with those of the first.

The cirri are XV–XXV (usually about XX), 15–28 (usually 20–24), from 15 to 18 mm. long. The first 4 (less commonly only the first 3) segments are subequal, about twice as broad as long, slightly shorter in the first. The next segment is usually about as long as broad, though rather variable, sometimes longer and sometimes shorter. The fifth or sixth is a transition segment, about one-third again as long as broad. The next segment is slightly shorter, and the following are about as long as broad. Those succeeding gradually decrease in length so that the outermost 12–14 are subequal, about half again as broad as long. The transition and following segments have the distal dorsal edge raised into a coarsely dentate transverse ridge which on the next 2 or 3 segments following the transition segment becomes concave and then rather strongly V-shaped, with a rather large tooth at the apex of the V, and 2 smaller ones on either side. Distally the median tooth gradually increases in prominence and the lateral teeth become less marked until on the 2 or 3 segments before the penultimate the lateral teeth nearly or quite disappear, leaving the median tooth as a prominent median dorsal spine which is slightly curved distalward.

The opposing spine is median, slender, slightly curved distalward, equal in height to about one-third the width of the penultimate segment; it is about as long as the 1 or 2 spines preceding. The terminal claw is about half again as long as the penultimate segment, stout and strongly curved basally but becoming straighter and more slender distally.

The ends of the basal rays are visible as rather prominent tubercles in the angles of the calyx.

The radials are concealed by the centrodorsal. The IBr_1 are oblong, very short, closely united laterally, and usually somewhat concealed by the centrodorsal. The IBr_2 (axillaries) are short, broad, almost or quite triangular, from two to two and one-half times as broad as long, nearly or quite in contact laterally. The IIBr series are 4 (3+4), rarely 2, well rounded dorsally; the pinnules borne by the $IIBr_2$ are usually almost, sometimes quite, in apposition. The IIIBr series are 3 (2+3), usually not developed on more than half the rays and often altogether absent. The IVBr series are 3 (2+3), but are rarely developed; when present they are widely separated from their neighbors.

The arms are 12–35 in number, most commonly 18–24, from 100 to 125 mm. in length. The first brachials are wedge-shaped, longer outwardly than inwardly, about twice as broad as the median length, and entirely united interiorly. The first syzygial pair (composed of brachials 2+3) is most commonly about twice as broad as long, or somewhat broader. The next 2 or 3 brachials are oblong, about three times as broad as long, and those following become more or less, in the best developed individuals only slightly, wedge-shaped, three or four times as broad as long, soon gradually becoming oblong again, in the outer three-fourths of the arm being regularly oblong, approximately four times as broad as long, but becoming longer again and more wedge-shaped at the tip. After the first 3 the brachials have very prominent finely spinous distal ends. The elements of the IIBr and IIIBr series also usually have their distal ends everted and prominent. The arms usually increase more or less markedly in width from the first to about the twentieth brachial, in extreme cases being twice as broad here as at the base; beyond the twentieth brachial the arm remains of practically the same width for some time, then tapers gradually to the tip. In many individuals, especially those with a comparatively small number of arms, this increase in width of the proximal portion of the arm is but little marked.

Syzygies occur between brachials 2+3 (on arms arising from a IBr axillary brachials 3+4), again from between brachials 14+15 to between brachials 43+44 (usually in the vicinity of the sixteenth-twentieth brachials), and distally at intervals of from 4 to 13 (usually from 6 to 8) muscular articulations.

In arms arising from a IBr axillary there may be an additional syzygy at no great distance from the first; but this is frequently absent.

The mouth is radial, usually marginal or nearly so, but frequently subcentral and occasionally quite central. The anal tube is usually subcentral. The disk, which is most commonly from 15 to 20 mm. in diameter, usually bears a few scattered calcareous granules, mostly in the anal area, but is frequently naked.

P_D is from 12 to 15 mm. long, rather stout at the base, but becoming slender after the first 5 or 6 segments. It is composed of about 40 segments, of which the first 6 to 8 are broader than long (usually about twice as broad as long) and the remainder are about as long as broad. The terminal comb is composed of 12 teeth which are about twice as long as broad at the base, most of them slightly longer than the width of the segments which bear them, and slightly recurved. P_P is similar to P_D though not so stout basally and 2 or 3 mm. shorter. It is composed of about 35 segments, of which the first 3 decrease rapidly in width, the pinnule tapering very gradually from that point onward. From the fifth outward the segments are about as long as broad. The second segment is usually carinate. In arms arising from a IBr axillary P_1 is as described for P_D, and P_2 is as described for P_P. In arms arising from a IIBr axillary P_1 is as described for P_P. On such arms P_2 is 9 mm. long, more slender basally than the preceding pinnules, composed of 30 segments, of which the first 2 are much broader than long, the second carinate, and those after the fourth are about as long as broad. P_3 is similar, but the second segment is usually not carinate. P_4 is similar, about 8 mm. long. P_5 and the following pinnules are of about the same length but slightly stouter and composed of slightly shorter and rather strongly overlapping segments. The terminal comb persists usually up to P_7 or P_{10}, more rarely extending to P_{15}, or disappearing after P_4.

The distal pinnules are similar in length to the middle pinnules, but are more slender. They are composed of 16 or 17 segments, of which the first is short, the second is not quite so long as broad, the third is somewhat longer than broad, and the following gradually increase in length, being somewhat over twice as long as broad distally, but short again terminally.

The color in alcohol is very variable; reddish or blackish brown; purple; violet; greenish gray; bright yellow; creamy white; the dark specimens sometimes have the disk mottled with white, and the pinnules nearly white with the tips and the perisome black.

Notes.—The specimen from Hulule, Maldives, is a fine example with 22 arms.

Of the 4 specimens collected by Sarasin in Ceylon and recorded by Reichensperger, 1 has 16 arms 60 mm. long and the cirri XX with some 20 segments, 15 mm. long; the IIIBr series are all 3 (2+3); the brachials are moderately broad; in spite of the number of arms this strongly recalls the form described by Bell as *coppingeri*. A second specimen has exactly 20 arms, with the brachials markedly shorter than in the first, and XVIII cirri from 17 to 19 mm. in length. The two remaining specimens have 27 and 29 arms which are about 100 mm. long and are composed of narrow brachials; the cirri are XXI and XIX, from 20 to 22 mm. in length; these are typical of *fimbriata* as described by Carpenter.

Of the 2 specimens from *Investigator* station 152, 1 has 18 arms about 90 mm. long gradually increasing in diameter to about the twelfth brachial, and from that point gradually tapering distally; the brachials are very short.

The specimen recorded by Chadwick from Ceylon Pearl Oyster Fisheries station IX has 12 arms.

Of the 2 specimens examined from Tuticorin, 1 has 21 and the other 25 arms.

The specimen recorded by Chadwick from Ceylon Pearl Oyster Fisheries station LXVI has 22 arms; the width of the arms increases gradually from the first to about the twentieth brachial.

The 5 specimens recorded from ?India (probably Ceylon) are all small or medium sized.

Of the 2 specimens from the Arrakan coast, 1 has 19 and the other 26 arms.

One of the specimens from *Investigator* station 387 has 15 arms; of the 5 IIBr series present, 1 is 2 instead of the usual 4 (3+4). One of the other specimens has 38 arms 80 mm. long, and the third has 42 arms 90 mm. long. Both of these last approach in their general facies *C. sentosa.*

The example from 8 miles west of Interview Island, Andamans, has 11 arms 85 mm. long.

The specimen from off Rutland Island, Andamans, has 12 arms 85 mm. long which are composed of short discoidal brachials on which the eversion of the distal ends is more marked than usual. The eversion of the distal ends of the cirrus segments is exceedingly strong and continues all around excepting in the middle of the ventral side, not being confined to the middle of the dorsal side as usual. The central spines on the dorsal side of the cirrus segments are correspondingly enlarged.

Of the 4 specimens from *Investigator* station 239, 2 have 11, 1 has 12, and 1 has 13 arms.

Of the 9 specimens collected by the *Investigator* at the Andaman Islands 4 are small; of the others one has 13 arms, one 15, one 17, one 19, and one 21. The arms of the 15-armed specimen are 100 mm. long and are composed of short discoidal brachials which are strongly overlapping. The 13-armed specimen is of full size with the short discoidal brachials of the fully adult.

Of the 2 specimens from off Great West Torres Island, both of which are small, 1 has 13 arms and is undergoing adolescent autotomy.

Of the specimen from Sumatra, Carpenter says that the radials are almost completely concealed; there are 23 cirrus segments; the second syzygy may be as early as between brachials 12+13, while the distal intersyzygial interval may rise to over 20 muscular articulations.

The 6 specimens from the southern portion of the Straits of Malacca have from 17 to 21 arms. One of them is typical of the species. It has 20 arms 75 mm. long. All 10 of the IIBr series are present, and all are 4 (3+4). The arms and division series are typically stout and the brachials are typically short. The distal edges of the brachials are more strongly everted than usual and are finely spinous, and the distal edges of the elements of the division series are similarly everted and spinous.

Carpenter remarked that the 2 *Challenger* specimens from Banda and Zamboanga which were referred by him to *coppingeri* are linked together by another from Singapore which was given him by Prof. Charles Stewart.

The specimen from Singapore collected by Professor von Martens has 13 arms.

Of the specimens collected by Mr. Svend Gad at Singapore, one has 27 arms 105 mm. long, and the cirri XIV, 25, 20 mm. long. Another has 22 arms 90 mm. long, and the cirri XVIII, 30 mm. long. Another has 16 arms 65 mm. long; there are 3 IIBr and 2 IIIBr series present; the cirri are XIV, 20–25, from 15 to 20 mm. long. This specimen was parasited by a small gastropod (*Sabinella capillastericola*) attached near the base of one of the arms [see vol. 1, pt. 2, p. 648]. Another has 14 arms 60 mm. long, and the cirri XV, 15 mm. long. Another has 12 arms 65 mm. long, the 2 IIBr series being on one ray; the cirri are XVI, 17–18, from 10 to 17 mm. in length. This specimen bore another parasitic gastropod of the species mentioned above on the dorsal side of one of the cirri near the base. Another specimen has the arms 70 mm. long, and the cirri XVI, 15 mm. long. Another has the arms 45 mm. long; one IIBr series is just developing and is already giving off a IIIBr series. Other specimens have 29, 26, 23, and 21 arms.

Other specimens at hand from Singapore show the following characters:

The arms are 22 in number, 75 mm. long. The IIIBr series are all internally developed. There are 23–24 cirrus segments.

The 29 arms are 80 mm. long. The IIIBr series are developed both internally and externally. The centrodorsal is thin discoidal, bearing the cirri in a single irregular marginal row. The dorsal pole of the centrodorsal is 5 mm. in diameter, and is slightly sunken in the center. The cirri are XVIII, 20–22.

The 22 arms are 100 mm. in length. One of the IIBr series is missing. The 3 IIIBr series are all internally developed. The cirri are XXI, 24–26, from 20 to 23 mm. long. They are rather stout, especially basally, tapering rather rapidly as far as the seventh segment, which is a transition segment, but becoming of more uniform width from that point onward.

One specimen has 23 arms 65 mm. long, and 2 others have 23 and 26 arms, in both 80 mm. long. One has 20 arms 55 mm. long, and another 17 arms 50 mm. long.

A very small specimen has 10 arms 40 mm. long. One arm is broken off at the first syzygy, and a bud showing an axillary and 4 brachials is forming. The cirri have 14–15 segments, and are from 5 to 7 mm. long.

Another very small specimen has 10 arms 35 mm. long. One of the arms is broken at the first syzygy and an axillary followed by 3 brachials is appearing. The cirri are of the adult type, but more slender than in large specimens.

A specimen from Singapore in the British Museum has 14 arms 120 mm. long, and the cirri 20 mm. long with 21 segments.

Carpenter noted that the specimen from the Nicobar Islands collected by the *Galathea* expedition has the brachials less strongly overlapping than the 2 specimens from Anjer, Java.

The specimen from the Malay archipelago in 183 meters has 40 arms about 70 mm. long.

Of the 3 specimens from the Malay archipelago in 292 meters 2 have about 40 arms which are 70 mm. long; the third is highly irregular and will be described under the abnormal specimens.

The 3 specimens from the Sunda Straits were studied by Carpenter. He gave the name of the collector as "Regnault" instead of Reynaud. Carpenter wrote that the cirrus spines in these specimens are of smaller size than those of Péron and Lesueur's specimen from the Australian seas (the type of Lamarck's *fimbriata*) and also appear on fewer segments; he noted also that in one of these specimens there are only 6 IIBr series so that there are only 16 arms instead of the usual 20. I reexamined these specimens at Paris in 1910.

Carpenter wrote that the 2 specimens from Anjer ["Angio"] in Java have overlapping brachials.

Of the 2 specimens from Sebesi Strait, 1 has 16 arms 90 mm. long, the other 14 arms 90 mm. long.

One of the specimens from the Danish Expedition to the Kei Islands station 85 has 1+3, 2+3, 2+4, 1+1, 2+4=23 arms; of the 8 IIBr series present 6 are 4 (3+4) and 2 are 2; of the 5 IIIBr series 4 are 3 (2+3) and 1, following a IIBr 2 series, is 2. The brachials are very short, almost discoidal. The cirri are XIX, 23–24, 20 mm. long. The other specimen has 1+1, 3+1, 4+1, 3+3, 4+1=22 arms; there are 5 IIBr series, all 4 (3+4), and 7 IIIBr series, all 3 (2+3). Five arms arise direct from a IBr axillary. The brachials are very short, almost discoidal. The cirri are XII, 23–26.

The specimen from the Danish Expedition to the Kei Islands station 103 is very small with 11 arms about 30 mm. long; the cirri are XI, 15, from 4 to 6 mm. long.

The example from the Danish Expedition to the Kei Islands station 75 has 30 arms 100 mm. long; the cirri are rather unusually stout, most of them with the longest segments scarcely so long as broad.

Of the 5 specimens from the Danish Expedition to the Kei Islands station 73 one has 20 arms 90 mm. long; there are 10 IIBr 4 (3+4) series. Another has 17 arms up to 75 mm. in length; this individual is undergoing adolescent autotomy; 2 of the postradial series have 2 IIBr series each, the other 3 one each; all the IIBr series are 4 (3+4). A small specimen has 17 arms. One example has 15 arms 90 mm. long; there are 5 IIBr 4 (3+4) series. The fifth specimen is small, with 12 arms 70 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 107 is small, with 28 arms 80 mm. long.

One of the specimens from the Danish Expedition to the Kei Islands station 67 has 43 arms; of the 10 IIBr series 9 are 4 (3+4) and 1 is 3; of the 19 IIIBr series 16 are 3 (2+3), 2 are 1, and 1 is 2; there are 4 IVBr series, all 3 (2+3). The brachials in the proximal third of the arms are short triangular, about two and one-half times as broad as the maximum outer length or slightly shorter. The cirri are XV, 20–22. Another specimen has 35 arms about 75 mm. long; of the 10 IIBr series 7 are 4 (3+4) and 3 are 2. A similar specimen has 32 arms.

One of the examples from the Danish Expedition of the Kei Islands station 101 has 20 arms 80 mm. long; there are 9 IIBr series, of which 8 are 4 (3+4) and 1 is 2; there is a single IIIBr 3 (2+3) series, internally developed, bearing two arms, one of which is about twice as large as the other. The other specimen has 20 arms up to 80 mm. in length; of the 10 IIBr series 8 are 4 (3+4), and 2, both on the same postradial series, are 2.

The 2 specimens from Billiton recorded by Professor Koehler have 27 and 31 arms; neither has any IVBr series.

In Grube's specimen from North Borneo (the type of *borneensis*) as described by him, the centrodorsal is slightly concave, deepened in the middle. The cirri are marginal.

The cirri are XX, 22–28, and long. From the fifth onward the segments are longer than broad; the last 12–18 segments bear 1 or 2 small dorsal spines.

The IBr_1 are visible. There are 10 IIBr series of 4 (3+4), and therefore 20 arms. The brachials are somewhat broader than long, and only toward the base of the arms are their distal ends slightly oblique, further out being parallel. Their distal edges are set with fine spines.

In the undivided arms the syzygies are between brachials 2+3, 13+14 (or 14+15 or 15+16), 19+20 (or 20+21), 26+27 (or 27+28), 33+34, 38+39, 44+45, 50+51, and 55+56.

The lowest pinnule is on the $IIBr_1$ and the next is on the first brachial; both of these, and also the following 2 or 3, are markedly longer than those following.

The disk extends to the second arm division. The mouth lies between the border and the center. The anal area is set with small calcareous concretions.

The color is dark.

Of the 2 specimens collected by Herr Pagel in British North Borneo, 1 has about 25 arms 110 mm. long; the IIIBr series are all 3 (2+3), and all internal; the other has 19 arms 85 mm. long, no IIIBr series being present.

One of the specimens from *Siboga* station 90 has 18 arms 105 mm. long; there are no IIIBr series present; the color is nearly black; the other has 14 arms 105 mm. long; there are no IIIBr series; the color is light brownish gray with a narrow band of very dark brown across each articulation.

The largest specimen from *Siboga* station 133 has 15 arms 85 mm. long; 1 of the IIBr series is 3 (2+3), the other 4 being 4 (3+4). Another has 19 arms 70 mm. long; 2 of the IIBr series are 2, one of these bearing internally a IIIBr 2 series. A third has 15 arms, there being 1 IIBr 4 (3+4) series on each ray. The fourth specimen, which is small, has 11 arms.

The specimen taken in the Sulu Sea in January, 1895, is rather small, mutilated, and without a disk. It has about 23 arms.

The 5 specimens dredged by Dr. Th. Mortensen off Jolo in about 36 meters on March 21, 1914, are all typical. Of the 3 dredged on March 17, 1914, 1 has 33 arms; of the 10 IIBr series 9 are 4 (3+4) and 1 is 2. IIIBr series occur on the inner side of each of the IIBr series, sometimes on the outer side also. The brachials are very short with slightly oblique edges. A similar specimen has 27 arms. There are 9 IIBr series present, all 4 (3+4); there are 8 IIIBr series, all 3 (2+3), and all internally developed. The third specimen is somewhat smaller than the 2 preceding with 23 arms; of the 9 IIBr series present 8 are 4 (3+4) and 1 is 2; the 4 IIIBr series, all internally developed, are all 3 (2+3). The example from about 46 meters has 14 arms, a IIBr 4 (3+4) series being developed on each of 4 postradial series. Of the 3 specimens from 33–55 meters 1 has 21 arms about 80 mm. long; there are 10 IIBr 4 (3+4) series, and a single IIIBr 3 (2+3) series which is externally developed. Another specimen has 17 arms 95 mm. long; there are 7 IIBr 4 (3+4) series. The cirri are XV, 22–24, from 15 to 20 mm. long. The opposing spine is laterally broadened with a chisel-shaped edge notched in the middle, forked, or is represented by 2 conical spines situated side by side and more or less widely separated basally. The third specimen is small with 12 arms 60 mm. long; one arm pair is just arising through adolescent autotomy. Both of the IIBr series are 4 (3+4).

The example from *Siboga* station 93 has 11 arms 50 mm. long; the single IIBr series is just forming through adolescent autotomy.

The details of the 10 specimens from *Siboga* station 99 are as follows: (1) twenty-six arms 95 mm. long; all of the IIBr series are present, and all are 4 (3+4); the 6 IIIBr series, all of which are internally developed, are all 3 (2+3). (2) Twenty arms 90 mm. long; all of the IIBr series are present, one 2, nine 4 (3+4). (3) Twenty arms 70 mm. long; all the IIBr series are present, and all are 4 (3+4). (4) Twenty arms 70 mm. long; all of the IIBr series are present. (5) Twenty arms 80 mm. long; all the IIBr series are present. (6) Twelve arms 60 mm. long; the 2 additional arms are just appearing through adolescent autotomy. (7) Fourteen arms. (8) Fourteen arms. (9) Twelve arms. (10) Ten arms.

According to Carpenter the specimen from *Challenger* station 212 has 20 arms which are relatively large, though the cirri are small; the terminal combs on the lower pinnules are rarely found beyond the eighth brachial.

One of the specimens from *Albatross* station 5249 has 20 arms which are composed of oblong and strongly overlapping brachials; all of the IIBr series are present. The other specimen is small.

The specimen from Bantayan reef, Cebu, has 19 arms.

The example from *Albatross* station 5482 has about 30 arms.

Carpenter noted that in the specimen from *Challenger* station 208 there is a small spine on the distal dorsal edge of the fifth cirrus segment; on the following segments it gradually develops into a crest bearing a variable number of spinelets which sometimes give rise to a double opposing spine on the penultimate.

Some of the specimens from Port Galera, Mindoro, present the following features: (1) Twenty-four arms about 135 mm. long, composed of very short brachials the ends of which are armed with very numerous closely set spines in several rows; the cirri are XXV, 18–21; the dorsal pole of the centrodorsal is 4 mm. in diameter. (2) Twenty arms about 120 mm. long; all of the IIBr series are present, 2 being 2 and the remaining 8 being 4 (3+4); the arms broaden considerably to about the twelfth brachial; the brachials are very short, discoidal, with very prominent ends which are armed with several rows of very fine closely set spines. (3) Thirty-seven arms 120 mm. long; the brachials are short, and their distal ends bear numerous closely set small spines; the centrodorsal is 4 mm. in diameter. (4) Twenty-two arms 135 mm. long; there are 20–21 cirrus segments; the centrodorsal is 4 mm. in diameter. (5) Twenty arms, all the IIBr series being present, all 4 (3+4); the arms are slender, the brachials being longer than usual, and the division series are narrow. (6) Twenty arms 130 mm. long. (7) Seventeen arms 170 mm. long. Other specimens have 23, 22, and 20 arms.

Of the 2 specimens from *Albatross* station 5276, 1 has 13 and the other about 20 arms; the brachials are very short with almost perfectly parallel borders.

The specimen from the Macclesfield Bank in 40–55 meters has 17 arms.

The 5 specimens from the China Sea in the Göttingen museum recorded by Hartlaub are remarkable for their relatively slender build; they have from 25 to 35 arms.

The specimen from ?China in the Berlin museum is small, with 31 arms 80 mm. long.

The specimen from Formosa (Taiwan) which was recorded by Hartlaub in 1891 and which I reexamined at Hamburg in 1910 is a rather slender medium sized example with 36 arms and the cirri XII, 22–24.

The specimen from *Siboga* station 33 has 20 arms 100 mm. long; all of the IIBr series are developed.

The example from *Siboga* station 40 has 11 arms 90 mm. long.

The specimen from *Siboga* station 37 has 19 arms; 3 of the 8 IIBr series present are 2; one of these bears externally a IIIBr 2 series; on all the arms the first syzygy is between brachials 2+3.

The individual from *Siboga* station 47 has 20 arms 125 mm. long; the brachials are very short, discoidal, with the distal edges strongly everted and abundantly supplied with short spines so that the animal feels very dry or rough; 3 of the IIBr series are 2, and 1, paired with 1 of 2, is 1; the remaining IIBr series are 4 (3+4); the cirri are 22 or 23 mm. in length.

Of the 5 examples from *Siboga* station 49*a* the largest has 30 arms 100 mm. long; all of the internal IIIBr series are present, and all are 3 (2+3); the longest cirrus segments are not more than one-third again as long as broad; the color is deep violet, contrasting with the color of the others which are yellow brown, the smaller being lighter than the larger. Another specimen had 19 arms 90 mm. long; 2 of the IIBr series are lacking; there is 1 IIBr series of 3 (2+3), developed externally. Of the other 3 individuals, 1 has 13 arms 40 mm. long and the others 11 arms 55 and 50 mm. long.

The 3 specimens from *Siboga* station 50 are of medium size; 2 have 18 arms; in one of these there is a IIBr 2 series; the third has 14 arms 80 mm. long.

The specimen from *Siboga* station 299 has 19 arms 80 mm. long; there are no IIIBr series; the cirri are XVII, 18–20, 15 mm. long.

The specimen from *Siboga* station 80 is a very fine example; it has 20 arms 140 mm. long; all of the IIBr series are present, and all are 4 (3+4); the cirri are XIII, 20–21, 15 mm. long; the longest cirrus segments are not more than one-third again as long as broad; the brachials are very short with strongly produced distal edges. The animal is very robust.

Of the 4 specimens from *Siboga* station 294, the largest has 14 arms 35 mm. long; all of the IIBr series are 4 (3+4); another has 11 arms 35 mm. long; the single IIBr series is 4 (3+4); the other 2 have 10 arms.

The specimen from *Siboga* station 296 has 15 arms; 1 of the IIBr series is 2; this example is of small size.

The specimen from *Siboga* station 282 has 20 arms.

The specimen from *Siboga* station 285 is very small with 10 arms.

One of the specimens from *Siboga* station 144 has 18 arms, there being no IIBr series on one ray; the other has 17 arms 95 mm. long and is evidently young.

Of the 2 specimens from Ternate, which I examined at Hamburg, 1 has 15 and the other 17 arms; the brachials of both have very strongly everted distal edges.

The specimen collected by Professor von Martens at Amboina has 20 arms 115 mm. long.

Of the 3 specimens collected by Dr. Th. Mortensen at Amboina in about 1 meter, 1 is large with 19 arms 135 mm. long; of the 9 IIBr series present 5 are 4 (3+4) and 4 are 2. A second example has 21 arms 130 mm. long. The single IIIBr series, which is internally developed, is 2. On the 2 arms following this IIIBr series the first syzygy is between brachials 30+31 on one and between brachials 33+34 on the other. The third specimen has 18 arms; there are 8 IIBr 4 (3+4) series.

The specimen from Amboina in about 2 meters had probably 20 arms which are 90 mm. long; 10 IIBr 4 (3+4) series are present. The centrodorsal is thin discoidal with the concave dorsal pole 4 mm. in diameter. The cirri are XVI, 20–22, from 15 to 17 mm. long, most of them more or less undeveloped.

The specimen from off Neira, Banda, in 13 meters has 27 arms 130 mm. long. Of the 10 IIBr series present 8 are 4 (3+4) and 2 are 2; the 7 IIIBr series are all 3 (2+3). The cirri are XX, 23, 18 mm. long. Of the 5 specimens from off Neira in about 15 meters, 1 has 20 arms 90 mm. long; of the 10 IIBr series 6 are 4 (3+4) and 4 are 2. One has 19 arms 100 mm. long; there are 8 IIBr series, 6 of which are 4 (3+4) and 2 are 2; there is a single IIIBr 2 series internally developed. Another has 19 arms 85 mm. long; of the 9 IIBr series 3 are 4 (3+4) and 6 are 2. A specimen with 19 arms has 3 IIBr 4 (3+4) series, 5 IIBr 2 series, and a single IIBr 3 series. The last specimen has 19 arms; of the IIBr series 5 are 4 (3+4) and 4 are 2. Of the 8 specimens from off Banda in about 20 meters, 1 has 24 arms; 3 of the IIBr series are 4 (3+4), 6 are 2, and 1 is 3 (2+3); there are 4 IIIBr series, 2 of which are externally developed on a single postradial series, the other 2 being on a single IIBr series; of the latter the external is 2 (1+2) and the internal is 3 (2+3), as are the other 2. One specimen has 22 arms 150 mm. long; of the 10 IIBr series 7 are 4 (3+4) and 3 are 2; there are 2 IIIBr series, 1 internal and the other, following a IIBr 2 series, external. The cirri are XX, 24, 20 mm. long. One specimen has 21 arms; of the 10 IIBr series 8 are 4 (3+4) and 2 are 2; the single IIIBr 3 (2+3) series is internally developed. One specimen has 20 arms with 10 IIBr 4(3+4) series. Two specimens have each 19 arms with 9 IIBr 4 (3+4) series; the arms are 80 mm. long in one and 90 mm. long in the other. One specimen has 19 arms 160 mm. long; of the 9 IIBr series 8 are 4 (3+4) and 1 is 2. This example is not larger than those preceding, but the arms are lengthened and attenuate. The last specimen is small with 10 arms. The specimen from about 25 meters has 19 arms 80 mm. long; there are 9 IIBr 4 (3+4) series; the distal edges of the brachials are rather strongly everted and abundantly armed with small spines. The specimen from Lontor has 15 arms 90 mm. long; the

5 IIBr series are 4 (3+4). The brachials are very short with their edges almost parallel. In all of the specimens from Banda the distal edges of the brachials are rather strongly everted and abundantly spinous.

The *Challenger* specimens from Banda have not more than 18 cirrus segments. In one of them the carination of the basal segments of the lower pinnules seems to be almost entirely absent, although it is present in the others.

Of the 2 specimens from *Siboga* station 240, at Banda, the larger has about 26 arms which are about 105 mm. long; 3 of the IIBr series are 2; the IIIBr series are 3 (2+3). The cirri are XV, 24–26, from 22 to 25 mm. in length.

The individuals from *Siboga* station 162 are small; 1 has 14 arms with all the IIBr series 4 (3+4), and the other has 13 arms with 1 of the IIBr series 2 and the 2 others 4 (3+4).

The specimen from *Siboga* station 250 has 14 arms 50 mm. long and the cirri XIII, 14 mm. long.

Of the specimens from the Danish Expedition to the Kei Islands, that from station 11 has 19 arms 120 mm. in length; the 9 IIBr series are all 4 (3+4).

One of the specimens from station 14 has 25 arms; there are 9 IIBr series, all 4 (3+4); of the 6 IIIBr series 4 are 3 (2+3) and 2 are 2 (1+2). Another has 21 arms; of the 10 IIBr series 8 are 4 (3+4) and 2 are 2; there is a single IIIBr 3 (2+3) series, internally developed. The third specimen has 17 arms 120 mm. long; there are 7 IIBr 4 (3+4) series.

The example from station 15 has 21 arms 85 mm. long; of the 10 IIBr series 7 are 4 (3+4), 2 are 2, and 1 is 1. The IIBr 1 series bears externally a IIIBr 3 (2+3) series. The brachials are very short and their distal edges, which are parallel, are very strongly produced and very spinous.

Of the specimens from station 20, 1 has 14 arms 100 mm. long, there being 4 IIBr 4 (3+4) series present. Another has 13 arms 90 mm. long, with 3 IIBr 4 (3+4) series. The third is much broken.

One of the specimens from station 21 has 20 arms 115 mm. long; of the IIBr series 8 are 4 (3+4) and 2 are 3. The brachials are very obliquely wedge-shaped, about twice as broad as the longer side. The color is olive brown, with the dorsal surface of the arms and the dorsal pole of the centrodorsal thickly and evenly sprinkled with minute white dots which become much larger on the interbrachial articulations and on the ventral perisome, and confluent along the sides of the pinnules. The second specimen is undergoing adolescent autotomy; 3 IIBr series, 2 of 2 elements and 1 of 4 (3+4), are just beginning to appear.

Of the 3 specimens from station 26, 1 has 19 arms 95 mm. long; there are 9 IIBr 4 (3+4) series present. A second has 11 arms 95 mm. long; there is a single IIBr 4 (3+4) series. The third has 11 arms, there being a single IIBr 4 (3+4) series.

The example from station 27 has 13 arms 120 mm. long; there are 3 IIBr 4 (3+4) series. The brachials are very short with parallel edges and the distal edges strongly produced and very spinous.

One of the specimens from station 30 has 21 arms 130 mm. long; there are 9 IIBr series present, all 4 (3+4); the 2 IIIBr series are both 3 (2+3). The brachials are short with slightly oblique ends; the dorsal surface is roughened and the distal ends are armed with very numerous fine spines. Another has 19 rather stout arms which broaden considerably from the base to about the sixteenth brachial, where they are about twice as broad as they are at the base. Of the 9 IIBr series, 8 are 4 (3+4) and 1 is 2. The dorsal surface of the arms and pinnules and the dorsal pole of the centrodorsal are thickly and evenly sprinkled with small white dots, which are larger on the interbrachial lines. The ventral perisomic surface has similar but larger dots. A third specimen has 20 arms 75 mm. long; the 10 IIBr series are all 4 (3+4), and are in close lateral apposition. The base of the pinnule on the $IIBr_2$ (P_D) is large, making the following syzygial pair appear unusually narrow. A specimen with 18 arms 110 mm. long has 6 IIBr series, 3 of which are 4 (3+4), the other 3 being 2. The 2 IIIBr series are both internally developed on the same postradial series; one of these is 2 and the other is 5 (2+3); in the latter the third ossicle is shaped like an axillary, but bears a single ossicle. Following this division series, one of the arms has the first syzygy between brachials 4+5, while the other has it between brachials 2+3. The remaining specimen has 18 arms 115 mm. long; there are 8 IIBr 4 (3+4) series. The cirri are of various sizes, only 2 being fully grown. The longest have 24–27 segments and are from 23 to 26 mm. long.

One of the specimens from station 31 has 22 arms 130 mm. long; there are 10 IIBr 4 (3+4) series and 2 IIIBr 3 (2+3) series, both of the latter interiorly developed on the same ray. The cirri are XIII, with a few additional undeveloped, 22–25, from 21 to 23 mm. long. A second specimen has 22 arms 130 mm. long; there are 10 IIBr 4 (3+4) series and 2 IIIBr 3 (2+3) series, both of the latter being internally developed. The cirri are XIII, with some additional undeveloped, 21–24, from 15 to 17 mm. long. Another example has 21 arms 130 mm. long; there are 10 IIBr 4 (3+4) series and a single IIIBr 3 (2+3) series, internally developed. The cirri are XVI, 21–25, 20 mm. long. The fourth specimen has 19 arms 100 mm. long; there are 9 IIBr 4 (3+4) series, the tenth IIBr series being represented by 2 ossicles, of which the outer bears a pair of pinnules. The cirri are X, 25–27, from 22 to 25 mm. long.

Of the 4 specimens from station 38, 1 has 22 arms 120 mm. long, 10 IIBr 4 (3+4) series being present; there are 2 IIIBr 3 (2+3) series, both internally developed. Another has 20 arms 110 mm. long, with 10 IIBr 4 (3+4) series. A third has 18 arms 95 mm. long; of the 8 IIBr series, 6 are 4 (3+4) and 2 are 2. The fourth has 16 arms 120 mm. long; the arms are rather slender, and the brachials are short and slightly wedge-shaped. The cirri are XVII, 24–26, 25 mm. long. There is a single IIIBr 3 (2+3) series.

The specimen from station 40 is rather large with 19 arms 125 mm. long. There are 9 IIBr 4 (3+4) series present. The arms are unusually stout. They increase in width to about the twentieth brachial, where they are twice as broad as at the base, and thence taper distally. The cirri are XVIII, the longest with 29–30 segments and 22 mm. in length. The color is olive brown, regularly and abundantly speckled with small white spots, excepting only on the cirri. These spots are largest on the perisomic articular lines between the brachials and on the perisome between the pinnule bases. Terminal combs occur, becoming more and more reduced, until near the end of the arms.

The example from station 53 has 15 arms 140 mm. long. There are 5 IIBr 4 (3+4) series. The cirri are XII, 31–32, from 25 to 30 mm. long.

One of the specimens from station 54 has 18 arms about 80 mm. in length. There are 7 IIBr 4 (3+4) series, and a single internally developed IIIBr 3 (2+3) series. The brachials have very oblique, strongly produced, and very spinous distal edges. Another specimen has 16 arms about 130 mm. long; 7 arms, including 3 IIBr series, are just in process of regeneration. The third specimen from this station has 10 arms 65 mm. long. The cirri are XII, 21, 20 mm. long.

The 2 specimens collected by Dr. H. Merton at the Aru Islands were thus described (as *Capillaster clarki*) by Reichensperger.

The centrodorsal is pentagonal, discoidal, with a flat or slightly concave dorsal pole, from 6 to 7 mm. in diameter. The cirrus sockets are arranged in 2 irregular rows.

The cirri are XXVIII–XXXIV, 20–21, about 15 mm. long, and stout. The first segment is twice as broad as long, the two following are somewhat longer, and the fourth is about as long as broad. The fifth-seventh segments are somewhat longer than broad, the eighth is about as long as broad, and the remainder are all about twice as broad as long. From the eighth onward the segments carry a prominent keel or tooth on the dorsal side. The fifth or sixth is a transition segment. The terminal claw is somewhat longer than the penultimate segment.

The radials are entirely concealed. The IBr_1 are partly concealed, short and broad, laterally in contact with their neighbors. The IBr_2 (axillaries) are short pentagonal, almost triangular, over twice as broad as long. In the larger specimen the IIBr series are all 4 (3+4). The $IIBr_1$ is discoidal, about three times as broad as long; the $IIBr_2$ is twice as long externally as internally; the $IIBr_3$ is very short, and the $IIBr_4$ (axillary) is also short, low triangular.

The arms are 27–35 in number, from 85 to 100 mm. long. They are of moderately well rounded form and first begin to taper rapidly in the outer half. In the larger specimen all the IIIBr series are 3 (2+3). The first segments following each axillary are almost wholly united. The first brachial is relatively long, almost square, but somewhat longer externally than internally. The second and third brachials are short discoidal, together slightly shorter than the first. The fourth brachial is similar to the second and third together. On the fifth the brachials begin to become wedge-shaped with strongly overlapping distal ends. In the distal third of the arms the brachials become smoother and also again more discoidal. The produced distal ends are mostly beset with very fine spines.

P_D is 20 mm. long and is composed of about 42 segments of which the first 12 are broad, in part twice as broad as long, and the remainder are about as long as broad. The poorly developed comb is composed of rounded triangular teeth and extends over from 6 to 8 segments. P_1 is 16 mm. long and is composed of 36 segments. P_2 is 10 mm. long with 28–30 segments, and P_3 is only 6 mm. long with 20 segments. P_1 and P_2 resemble P_D in structure. P_3 is very slender. The succeeding pinnules quickly become broader and longer and the distal pinnules are 9 to 10 mm. in length.

The diameter of the disk is about 20 mm. The mouth is interradial.

In life the cirri were yellow, the arms and disk greenish, the first with a few, the last with numerous irregular white blotches and dots; the pinnules were greenish black, each segment narrowly banded with white.

The specimen from *Siboga* station 274 has 20 arms 110 mm. long; there are 4 IIIBr series present, 3 internal and 1 external, the last paired with one of the internal. The cirri are XVII, 23–25, 20 mm. long; the longest cirrus segments are about one-third again as long as broad.

The details of the 8 specimens from *Siboga* station 273 are as follows: (1) Twenty-five arms 50 mm. long; of the 5 IIIBr series 4 are on 2 of the IIBr series and the fifth is externally developed. The cirri are XVI, 23, from 13 to 15 mm. in length; the longest cirrus segments are not over one-third again as long as broad. (2) Eighteen arms 65 mm. long; there are no IIIBr series; the brachials are short triangular. (3) Sixteen arms 60 mm. long; the brachials are short triangular. The cirri are XX, 16–18, 10 mm. long; the longest cirrus segments are not more than one-third again as long as broad. (4) Fifteen arms 80 mm. long; the brachials are short triangular. The cirri are XXIV, 17–21, 13 mm. long; the longest cirrus segments are about one-third again as long as broad. (5) Fifteen arms 65 mm. long; the brachials are short triangular; there is one IIIBr series, 3 (2+3), internally developed. The cirri are XX, 16–19, 10 mm. long; the longest cirrus segments are not more than one-third again as long as broad. (6) Fifteen arms 56 mm. long; the brachials are more nearly discoidal than in the preceding. The cirri are XXII, 19, 12 mm. long; the longest cirrus segments are less than one-third again as long as broad. (7) Fourteen arms 55 mm. long; the brachials are short triangular. The cirri are XXIV, 15–16, 10 mm. long; the longest cirrus segments are half again as long as broad. (8) Fourteen arms, small, undergoing adolescent autotomy. The longest cirrus segments are twice as long as broad. The disk bears about 24 large conical calcareous tubercles irregularly scattered over the anal area, and many small calcareous nodules on and at the base of the anal tube.

As described by Prof. F. J. Bell, the type specimen of *coppingeri* has the centrodorsal small; the cirri are XVII–XX, 17–20, arranged in two rows on the centrodorsal; the fourth-sixth cirrus segments are longer than broad, the rest not so long as broad; the spines, including the opposing spine, are obscure.

The radials are scarcely visible. The IBr_1 are three times as broad as long, partly in contact laterally. The IBr_2 (axillary) is almost triangular. The specimen has 12 arms, "but the normal number is probably 10." The first and second brachials are longer outwardly than inwardly; the first are in contact interiorly. The third and fourth brachials (according to Professor Bell) form an oblong syzygial pair. The next two brachials are oblong, those succeeding wedge-shaped with the distal edges slightly dentated; further out the brachials become more regularly oblong.

Syzygies (according to Bell) occur between brachials 3+4 and 11+12, and distally at intervals of about 6 muscular articulations.

Of the pinnules Professor Bell says "First pinnules on the third brachials longer than the second, and the second a little longer than the third; the fourth again rather longer. The succeeding ones of a fair length."

He gives the arm length as about 70 mm., the cirri as 7.5 mm. long, and the diameter of the disk as 4.5 mm.

The locality is recorded as "Flinders, Clairmont."

The figure is very generalized and schematic. The first brachial syzygy is shown as between brachials 3+4, the second between brachials 11+12, and those succeeding as regularly spaced.

I examined Bell's type specimen in the British Museum and found it to be quite a usual example of an immature *multiradiata*.

Péron and Lesueur's specimen from the Australian seas, which served Lamarck as the type of *fimbriata*, is a dried example with 20 arms. I failed to see this during my visit to the Paris Museum. Carpenter notes that it has a tolerably well-marked median tubercle dorsally at the articulation between the $IIBr_1$ and $IIBr_2$, of which there is hardly any trace in the other specimens examined by him, and that the intersyzygial interval appears to be 11–14 muscular articulations.

One of the 3 specimens from between Fremantle and Geraldton, Western Australia, has 25 arms 110 mm. long; there are 8 IIBr series present, four of them 4 (3+4) and four 2; there are 6 IIIBr series, five 3 (2+3), and one 2; there is one IVBr series of 3 (2+3) following a IIIBr series of 2. The cirri are XIII, 22–26, from 15 to 20 mm. long. The second example has 25 arms about 100 mm. long; of the 10 IIBr series 8 are 4 (3+4) and 2 are 2; the 5 IIIBr series are 3 (2+3). The cirri are XVI, 20–21, 17 mm. long. The third specimen is smaller and broken, but is similar to the others.

The specimen from Dirk Hartog Island has 21 arms due to the presence of 2 IIIBr series, developed internally, and the absence of 1 IIBr series. The brachials are of the exceedingly short discoidal type. There are VI functional cirri with 20–22 segments, and XIII rudimentary cirri of various lengths. The arms are 100 mm. and the cirri are 15 mm. in length.

The specimen from Mjöberg's station 1 was described by Gislén as follows:

The centrodorsal is small, discoidal, 1.5 mm. in diameter, with the dorsal pole concave and the margin swollen. The cirri are marginal.

The cirri are XIII, 9–14, 6 mm. long. The first segment is short, the third-fifth are about twice as long as broad, and those following decrease in length. In lateral view the last 5 are broader than those preceding. The penultimate segment is shortened on the dorsal edge. The fifth-eighth segments bear blunt distal knobs dorsally, and the ninth-eleventh bear distinct spines which do not, however, reach to more than about one-fifth the width of the segment. The terminal claw is long, three-fourths of the length of the penultimate and antepenultimate segments together, and is strongly curved.

The radials are visible. The elements of the IBr series are united by a syzygy which is quite as perfect as that between brachials 3+4. The IBr_1 are three times as broad as long, and a little longer than the visible portion of the radials from which they are separated by a well-marked articulation which has somewhat swollen borders. Of the 6 IIBr series present, 3 are composed of 2 elements and 3 of 4. In 2 of the IIBr series of 2 elements these are united by synarthry, while in the third they are united by syzygy. Where 4 elements are present there is either no syzygy at all, in regenerating arms, or they are in 2 syzygial pairs. Of the 3 IIIBr series present, 2 are 2 and 1 is 3 (2+3). The ossicles following each axillary are closely united interiorly at their bases.

The 19 arms are up to 40 mm. in length. The brachials up to and including the fifth are discoidal, to about the eighth without distal prominences, then wedge-shaped with produced distal ends which have dentate or knotty collarlike borders. The number of the brachials is from 50 to 70.

The first syzygy on the undivided arms is sometimes found between brachials 1+2, the second between brachials 3+4, and the third about the twelfth brachial. But in one case, at least, the third syzygy is between brachials 5+6. On 3 arms the first 2 syzygies are between brachials 3+4 and 6+7.

P_1 is 9 mm. long with about 30 segments. P_2 is 7 mm. long. P_3 is 5 mm. long. P_4 is 3 mm. long. The length of the following pinnules increases to 5 mm. The distal pinnules have 12–15 segments. The pinnules as far as P_4 have combs consisting of about 5 teeth, which are rolled tightly into little balls, and combs occur here and there as far as the eleventh pinnule. The distal pinnules have recurved spines dorsally on the outer segments, and the other pinnules are finely spinous dorsally.

Gislén originally described this specimen under the name of *Comaster multifida*, later reidentifying it as *Comanthus parvicirra*. But as is shown by his figure the cirri are those of a species of Capillasterinae, and the individual must therefore belong to a species either of *Capillaster* or of *Comatella*.

One of the IIIBr series is 3 (2+3); of the 6 IIBr series, 3 are composed of 4 ossicles. The characters are partly those of the genus *Capillaster* and partly those of the genus *Comatella*. The species actually represented is undoubtedly *Capillaster multiradiata*, which is more or less frequently subject to great and disconcerting irregularities in the division series, and in the distribution of the syzygies.

The single specimen secured by Dr. Hubert Lyman Clark at Mer, Murray Islands, has 19 arms about 100 mm. long, and the cirri XXI, 20–24. The color in life was "oral surface, black; dorsal surface, brown, the joints between the arm segments much darker; whole dorsal surface, including the cirri, heavily silvered or frosted with white." As preserved, dried, it is uniform light gray.

The specimen from Blanche Bay, New Britain, has 12 arms which expand very rapidly to about the sixteenth brachial, then taper distally. The brachials are shaped essentially as are those of *Comatula solaris*, being strongly convex externally with a strongly concave distal edge; they are also strongly triangular instead of being more or less oblong as usual.

The specimen from St. Matthias Island collected by Dr. G. Duncker is typical. The specimen from the same locality collected by Herr Schöde is small.

Dr. P. H. Carpenter noted that in the type specimen at Lund the centrodorsal partly conceals the IBr_1 which are closely united laterally, and the IBr axillaries are more triangular than in the Lamarckian type of *fimbriata*. The position of the second syzygy varies from between brachials 21+22 to between brachials 40+41.

Two of the three specimens without locality in the British Museum are highly irregular and will be noticed under the abnormal specimens.

Abnormal specimens.—One of the individuals from the Malay archipelago in 292 meters is most extraordinarily irregular. It has 36 comparatively stout arms about 70 mm. long. The division series are broad and are in close lateral apposition and, with the arm bases, more or less flattened against each other. The brachials are of the typical short discoidal type and have strongly produced distal edges. The distal edges of the elements of the division series are also slightly produced and finely spinous.

The details of the arm division are as follows:

Ray 1: Two IIBr series of 2 each; that to the left (as viewed dorsally) bears externally (on the left) a IIIBr series of 2, and internally (on the right) an undivided arm. Both of the undivided arms arising from the IIIBr series have the first syzygy between brachials 2+3, but the (internal) undivided arm arising from the IIBr series has the first syzygy between brachials 3+4. The IIBr series to the right bears internally (toward the left) an undivided arm on which the first syzygy is bteween brachials 3+4, and externally (toward the right) a IIIBr 5 (4+5) series the 2 derivatives from which have the first syzygy between brachials 2+3. The total number of arms on this ray is 6, arranged in 2, 1, 1, 2 order.

Ray 2: Two IIBr series of 2 each; that to the left bears 2 undivided arms on which the first syzygy is between brachials 3+4. That to the right bears inwardly (toward the left) a IIIBr 4 (3+4) series, both derivatives from which have the first syzygy between brachials 2+3, and outwardly (toward the right) an undivided arm on which the first syzygy is between brachials 3+4. The total number of arms on this ray is 5, arranged in 1, 1, 2, 1 order.

Ray 3: Two IIBr series of 2 each; that to the left bears externally (toward the left) an undivided arm on which the first syzygy is between brachials 2+3, and internally (toward the right) 2 IIIBr series all 4 derivatives from which have the first syzygy between brachials 2+3. The IIBr series to the right bears 2 undivided arms on which the first syzygy is between brachials 2+3. The total number of arms on this ray is 7, arranged in 1, 4, 1, 1 order.

Ray 4: Two IIBr series, that to the right 4 (3+4), that to the left 2. The IIBr 4 (3+4) series bears 2 IIIBr 3 (2+3) series; in the 4 derivatives from these the first syzygy is between brachials 2+3 in all cases except on the innermost arm (the furthest to the right) on which it is between brachials 15+16. The IIBr 2 series bears 2 IIIBr 2 series; of these the inner (to the left) bears 2 IVBr 3 (2+3) series; the outer (to the right) bears inwardly (to the left) a IVBr 3 (2+3) series and outwardly (to the right) an undivided arm. In all the derivatives from this IIBr 2 series the first syzygy is between brachials 2+3. The total number of arms on this ray is 11, arranged in 2, 2, 4, 3 order.

Ray 5: Two IIBr series of 2 each; that to the left bears externally (to the left) an undivided arm, and internally (to the right) a IIIBr 3 (2+3) series. That to the right bears internally (to the left) an undivided arm and externally (to the right) a IIIBr 2 series which bears internally (to the left) a IVBr 4 (3+4) series and externally (to the right) an undivided arm. All the first syzygies in the arms on this ray are between brachials 2+3. The total number of arms on this ray is 7, arranged in 1, 2, 1, 3 order.

On the arms in which the first syzygy is between brachials 2+3 the first brachials always bear pinnules; but on the arms in which the first syzygy is between brachials 3+4 the first pinnule is on the second brachial.

In this specimen all but 1 of the IIBr series are 2, while of the 10 IIIBr series present 5 are 2, 3 are 3 (2+3), 1 is 4 (3+4), and 1 is 5 (4+5); the 6 IVBr series are all 3 (2+3). In the 36 arms the first syzygy is between brachials 2+3 in 29, between brachials 3+4 in 6, and between brachials 15+16 in 1.

This specimen exhibits an unusual complex of characters. The division series of 2 are the division series of *Comatella*, representing the so-called compound type of arm division, and not the usual type of division series of two ossicles as illustrated by the genus *Dichrometra*. A large portion of this specimen, therefore, would be unhesitatingly referred to some species of *Comatella* were it studied without regard to the remaining portions. The division series of 4 (3+4) is of the type characteristic of the subfamily Comasterinae, and in particular of the genus *Comanthus*. The division series of 5 (4+5) is a variant of no particular significance. The syzygies between brachials 2+3 are those of the genus *Capillaster* and are normal for that genus only; those between brachials 3+4 are normal for the species of Comasterinae only when occurring on the inner arms, but when found on the outer arms are normal both for the species of Comasterinae and for the species of *Comatella*. The syzygy between brachials 15+16 is a variant.

Analyzed on the basis of the characters furnished by the division series and the arms, we find this specimen to represent the genus *Capillaster*, the genus *Comatella*, and the subfamily Comasterinae in the following proportions:

	Arm division	Arms	Total
	Per cent	*Per cent*	*Per cent*
Capillaster	38	75	56.5
Comatella	54	6	30.0
Comasterinae	6	17	11.5
[Variant]	[2]	[2]	[2.0]
	100	100	100.0

A specimen without locality in the British Museum has 17 arms about 40 mm. long. Three of the IIBr series are 2, and 2 are 4 (3+4); each of the latter bears internally a IIIBr 3 (2+3) series. The IIBr 2 series may be immediately followed by a syzygial pair (the normal first syzygial pair) or the first syzygy may be between brachials 2+3, these two types of proximal arm structure being of about equal frequency. There are 21 cirrus segments. Half of this animal would certainly be identified as *Comatella maculata*, the other half as *Capillaster multiradiata*.

In another specimen without locality in the British Museum 5 of the IIIBr series are 1, and 1 is 3 (2+3).

The specimen from Ruk, Caroline Islands, described by Hartlaub and reexamined by myself at Hamburg, has 28 arms; the cirri are XXI, 24–28. The brachials are short discoidal with strongly produced distal edges. Of the 10 IIBr series 8 are 2 (1+2) and 2 are 4 (3+4). The IIBr 2 (1+2) series are all followed by IIIBr series; of these IIIBr series 1 is 4 (3+4) and the remainder are 3 (2+3). The 2 IIBr 4 (3+4) series are not followed by IIIBr series. The first brachial syzygy is in all cases between brachials 2+3; the second varies from between brachials 26+27 to between brachials 36+37, and those following are very irregularly placed at intervals of sometimes only 4, often 6 or 7, sometimes as many as 18, muscular articulations. P_1 (on the first brachial) is almost as long as the pinnules on the division series, measuring about 14 mm. The disk, which is 15 mm. in diameter, bears numerous scattered calcareous concretions, especially in the anal area.

In the smaller specimen from the Aru Islands described under the name of *C. clarki* by Reichensperger one ray bears 2 IIBr series each of a single axillary ossicle; the IIBr series to the left bears outwardly (to the left) a IIIBr 2 series, and inwardly (to the right) a IIBr 3 (2+3) series; the IIBr series to the right bears outwardly (to the right) a IIIBr 3 (2+3) series and inwardly (to the left) an undivided arm. Another ray bears to the right a IIBr series consisting of a single axillary ossicle followed by 2 undivided arms and to the left a IIBr 2 series bearing inwardly an undivided arm and outwardly a IIIBr 3 (2+3) series. A third ray bears 2 IIBr 2 series, each of which bears to the right a IIIBr 4 (3+4) series; the IIBr series to the left bears outwardly a brachial followed by a syzygial pair beyond which the arm is broken off; that to the right has the succeeding ossicles broken away at the axillary face. In the first ray described the arms following the IIIBr series furthest to the right have the first syzygy between brachials 2+3; the undivided arm on the inner face of the same IIIBr axillary has the first syzygy between brachials 1+2; of the two arms following the inner (right hand) IIIBr series from the left IIBr series that to the right has the first syzygy between brachials 1+2 and that to the left has the first syzygy between brachials 2+3. In the second ray the undivided arms following the IIBr series to the right have in that to the right (outer) the first syzygy between brachials 2+3 and the second between brachials 7+8, and in that to the left (inner) the first syzygy between brachials 1+2; the undivided arm on the inner (right) side of the IIBr series to the left has syzygies between brachials 1+2 and 3+4; the 2 undivided arms following the IIIBr series on the outer (left) side of the IIBr series to the left have in that to the right the first syzygy between brachials 2+3 and in that to the left no syzygies before the fifth brachial at which point the arm is broken off. In the third ray the arm on the left hand face of the left IIBr axillary and that on the left-hand face of the axillary of the IIIBr series on the right-hand face of the same IIBr axillary, which are the only arms preserved, both have the first syzygy between brachials 2+3.

The specimen from *Albatross* station 5355 is small, with the arms about 70 mm. long. The right anterior radial is axillary, giving rise to 2 IBr series, 1 with 1 IIBr series and 3 arms, the other with 2 IIBr series and 4 arms. The 2 IBr series arising from the axillary radial diverge just as IIBr series diverge from a IBr axillary so that the anterior and the right posterior rays are much crowded. The left anterior ray is nearly twice the normal size, but of the 5 arms which it bears only one, which springs undivided from the IIBr axillary, is enlarged; the others, however, have just finished undergoing adolescent autotomy and may not yet have reached their full size.

In the specimen from Dirk Hartog Island, Western Australia, the mouth is considerably nearer the center of the disk than usual, and the anal area bears numerous scattered calcareous granules. About the margin of the disk there are several large rounded openings leading into blind cavities which usually occur at the bases of the large oral pinnules. In the largest of these cavities, which has two openings, there is an ambulacral groove in the interior. The disk is further peculiar in possessing two mouths, a supplementary mouth, not quite so large as the true mouth, being situated just to the right of it.

The example from *Siboga* station 37 has 19 arms; 3 of the 8 IIBr series are 2 and 5 are 4 (3+4); 1 of the IIBr 2 series bears externally a IIIBr 2 series.

In the specimen collected by Dr. J. Brock at Amboina 7 of the IIBr series are 2 and 3 are 4 (3+4).

In 1 of the specimens from *Siboga* station 133, which has 19 arms 70 mm. long, 2 of the IIBr series are 2, 1 of these bearing internally a IIIBr 2 series. In the largest specimen from the same station, which has 15 arms 85 mm. long, 1 of the IIBr series is 3 (2+3), the other 4 being 4 (3+4).

In a specimen with 20 arms 90 mm. long from *Siboga* station 99, 1 of the IIBr series is 2 the other 9 being 4 (3+4).

One of the specimens from Port Galera, Mindoro, has 2 IIBr series 2 and eight 4 (3+4).

The individual from *Siboga* station 47 has 20 arms 125 mm. long; the cirri are 22 or 23 mm. long; the brachials are very short, discoidal, with their distal edges strongly everted and abundantly supplied with short spines so that the animal feels very dry or rough; 3 of the IIBr series are 2, and 1, paired with 1 of 2, is 1; the other 6 are 4 (3+4).

A IIBr 2 series occurs in one of the 18 armed specimens from *Siboga* station 50.

There is a IIBr 2 series in the small 15-armed specimen from *Siboga* station 296.

One of the specimens collected by Dr. Th. Mortensen at the Kei Islands, station 14, has 2 of the IIIBr series 2 (1+2). The specimen from station 15 has 1 of the IIBr series 1, 2 of them 2, and 7 of them 4 (3+4). One of the specimens from station 21 has 2 of the IIBr series 3, the other 8 being 4 (3+4). In a specimen from station 30 there are 2 IIIBr series developed internally on the same postradial series, 1 of them 2 and the other 5 (2+3); in the latter the third element is shaped like an axillary, but bears merely a single ossicle. In one of the specimens from station 31 one of the IIBr series is represented by 2 ossicles, of which the outer bears a pair of pinnules. In one of the examples from station 85 there is a IIIBr 2 series following a IIBr 2 series. A specimen from station 65 has 1 IIBr series 3, the other 9 being 4 (3+4); of the IIIBr series 2 are 1, 1 is 2, and 16 are 3 (2+3).

The figure published by Carpenter of the *Challenger* specimen from Banda (pl. 60, fig. 2) shows 1 IIBr 2 series, and 3 IIBr 4 (3+4) series. The larger of the 2 *Siboga* specimens from Banda (*Siboga* station 240) has 3 of the 10 IIBr series 2.

A specimen collected by Dr. Th. Mortensen off Neira, Banda, in about 15 meters which has 19 arms has a IIIBr 2 series. Another, also with 19 arms, has a IIBr 3 series. A specimen from the same locality in about 20 meters with 24 arms has 1 of the IIBr series 3 (2+3) and 1 of the IIIBr series 2 (1+2).

A small 13-armed specimen from *Siboga* station 162 has one of the IIBr series 2.

In 1 of the specimens from between Fremantle and Geraldton, Western Australia, 4 of the 8 IIBr series are 2 and 4 are 4 (3+4); of the 6 IIIBr series 1 is 2 and 5 are 3 (2+3). In another 2 of the 10 IIBr series are 2 and 8 are 4 (3+4).

A specimen from *Investigator* station 387 with 15 arms has 1 of the 5 IIBr series 2, the other 4 being 4 (3+4).

P. H. Carpenter noted that this species sometimes has a double opposing spine.

Localities.—Hulule, Male, Maldive Archipelago [Bell, 1902; A. H. Clark, 1913] (1, B. M.).

Ceylon; Doctor Sarasin [Reichensperger, 1913].

Ceylon Pearl Oyster Fisheries station XLI; south of Galle, Ceylon, about 12 miles from land; about 183 meters; bottom masses of branched and ramifying foraminiferal tubes [Chadwick, 1904].

Investigator station 152; 11.5 miles S. 83° W. of Colombo Lighthouse, Ceylon; 48 meters; sand, shells, and coral; December 12, 1893 [A. H. Clark, 1912] (2, U.S.N.M. 34837, 34901).

Ceylon Pearl Oyster Fisheries station LIII; Gulf of Manaar; 10–12 miles north of Cheval Paar, and about 12 miles due west of Vankali (or Bangalli) Church; 14–16 meters; muddy sand with some dead shells [Chadwick, 1904].

Ceylon Pearl Oyster Fisheries station IX; Gulf of Manaar; in the southwest corner of West Cheval Paar, about 12 miles from land; 13 meters; bottom temperature 25.56° C.; specific gravity 1.023; bottom fine quartz gravel, nullipore concretions, and many dead young pearl oyster shells [Chadwick, 1904].

Tuticorin, Madras Presidency; E. Thurston [Bell, 1888; Thurston, 1894; A. H. Clark, 1913] (2, B. M.).

Ceylon Pearl Oyster Fisheries station LXVI; west coast of Ceylon from south of Donnan's Muttuvaratu Paar along the west of the northern part of Mutwal Island as far as off Mudalaikuli Paar; 18–64 meters; nullipore and orbitolites sand with some red algae and dead coral [Chadwick, 1904].

?India (probably Ceylon) [A. H. Clark, 1912] (5, I. M.).

Trinquemale, northeastern Ceylon; M. Reynaud, 1829 [J. Müller, 1849; P. H. Carpenter, 1879, 1888; A. H. Clark, 1911; locality given by the two last as Sunda Strait] (3, P. M.).

Investigator; Arrakan coast, Burma [A. H. Clark, 1912] (2, U.S.N.M., 34860, 34875).

Investigator station 387; off Cape Negrais, Burma, southwest of the mouths of the Irrawaddy River (lat. 15° 25′ N., long. 93° 45′ E.); 73–89 meters; sand and coral; November 16, 1909 [A. H. Clark, 1912] (3 U.S.N.M., 34864, 36082, 36298).

Investigator; 8 miles west of Interview Island, Andamans; 82 meters [A. H. Clark, 1912] (1, U.S.N.M., 34940).

Investigator; off Rutland Island, Andamans; 64 meters [A. H. Clark, 1912] (1, I. M.).

Investigator station 239; west of South Andaman Island (lat. 11° 49′ 30″ N., long. 92° 55′ 00″ E.); 100 meters; sand and stones; April 14, 1898 [A. H. Clark, 1912] (4, U.S.N.M., 34821; I. M.).

Investigator; Andaman Islands [A. H. Clark, 1912] (9, U.S.N.M., 34862, 34863, 34867, 34869, 34870, 34871; I. M.). Pl. 3, fig. 5.

Investigator; east of the Terribles (about 30 miles SE. ¾ S. from the south point of Western Borongo Island, Burma) (lat. 19° 27′ N., long. 93° 18′ E.); 24 meters [A. H. Clark, 1912] (3, U.S.N.M., 34835, 34836, 34941).

Investigator; 2 miles off Great West Torres Island, Mergui Archipelago [A. H. Clark, 1912] (2, I. M.).

Sumatra [P. H. Carpenter, 1882; A. H. Clark, 1912] (1, H. M.).

Investigator; southern portion of the Straits of Malacca [A. H. Clark, 1912] (6, U.S.N.M., 34852, 34855, 34857, 34858, 34859; I. M.).

Singapore; Prof. Charles Stewart [P. H. Carpenter, 1888].

Singapore; Professor von Martens [A. H. Clark, 1912] (1, Berl. M., 2455).

Singapore; Svend Gad [A. H. Clark, 1909] (26, U.S.N.M., 35026, E.1086; C. M.).

Singapore [A. H. Clark, 1913] (1, B. M.).

Galathea; Nicobar Islands [P. H. Carpenter, 1888; A. H. Clark, 1909] (1, C. M.).

Investigator; Malay Archipelago; 183 meters [A. H. Clark, 1912] (1, I. M.); same, 292 meters [A. H. Clark, 1912] (3, U.S.N.M., 34843, 34854, 34861).

Anjer, Java [P. H. Carpenter, 1888; A. H. Clark, 1909] (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 90; Sebesi Strait, between Sumatra and Java; 36 meters; August 1, 1922 (2).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 85; Sunda Straits, between Sumatra and Java (lat. 5° 53′ S., long. 105° 34′ E.); 25 meters; muddy sand; July 31, 1922 (2).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 103; Sunda Straits (lat. 6° 05′ S., long. 105° 42′ E.); 52 meters, shelly bottom; August 4, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 75; Sunda Straits (lat. 6° 10′ S., long. 105° 44′ E.); 40 meters; sand and shells; July 29, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 73; Sunda Straits (lat. 5° 57′ S., long. 105° 57′ E.); 30 meters; hard bottom; July 28, 1922 (5).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 107; Java Sea, north of western Java (lat. 5° 57′ S., long. 106° 07′ E.); 49 meters; sand, stones, and sponges; August 5, 1922 (1).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 67; Java Sea, north of western Java (lat. 5° 48′ S., long. 106° 12′ E.); 38 meters; sand and shells; July 27, 1922 (3).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Java Sea; 49 meters; sand, stones, and sponges; August 5, 1922 (2).

Java Sea; J. Scherpbier, 1896 [A. H. Clark, 1911] (1, L. M.).

Billiton [Koehler, 1895].

North Borneo [Grube, 1875].

British North Borneo; Herr Pagel [A. H. Clark, 1912; Hartmeyer, 1916] (2, Berl. M., [4744] 6373).

Siboga station 90; Makasser Strait, between Borneo and Celebes (lat. 1° 17′ 30″ N., long. 118° 53′ 00″ E.); 281 meters; coral sand and stones; June 21, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 80; Borneo Bank (lat. 2° 25′ 00″ S., long. 117° 43′ 00″ E.); 40–50 meters; fine coral sand; June 13, 1899 (2, U.S.N.M., E. 412).

Albatross station 5641; Buton Strait, Philippines; Kalono Point (W.) bearing N. 61° W., 3.4 miles distant (lat. 4° 29′ 24″ S., long. 122° 52′ 30″ E.); 71 meters; sand and shells; December 14, 1909 (1, U.S.N.M., 35958).

Siboga station 133; anchorage off Lirung, Salibabu Island, Talacer Islands; down to 36 meters; mud and hard sand; July 25–27, 1899 [A. H. Clark, 1918] (4, Amsterdam Mus.).

Sulu (Jolo) Sea; ?U. S. Exploring Expedition (1, U.S.N.M., 3063).

Sulu Sea; January, 1895 (1).

Albatross station 5165; Tawi Tawi group, Jolo (Sulu) archipelago; Observation Island bearing N. 70° W., 6.4 miles distant (lat. 4° 58′ 20″ N., long. 119° 50′ 30″ E.); 16 meters; coral; February 24, 1908 [A. H. Clark, 1908, 1909] (5, U.S.N.M., 34872, 34908).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo (Sulu); about 36 meters; March 21, 1914 (5); same, March 17, 1914 (3); about 46 meters; sand and coral; March 20, 1914 (1); about 36–55 meters; sand and coral; March 19, 1914 (3).

Albatross station 5163; Tawi Tawi group; Observation Island bearing N. 79° W., 6.7 miles distant (lat. 4° 59′ 10″ N., long. 119° 51′ 00″ E.); 51 meters; coral sand; February 24, 1908 [A. H. Clark, 1908] (5, U.S.N.M., 34953).

Albatross station 5161; Tawi Tawi group; Tinakta Island (E.) bearing N. 12° W., 1.8 miles distant (lat. 5° 10′ 15″ N., long. 119° 53′ 00″ E.); 29 meters; fine sand; February 22, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34873).

Albatross station 5159; Tawi Tawi group; Jolo (Sulu) Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5° 11′ 50″ N., long. 119° 54′ 00″ E.); 18 meters; coarse sand; February 21, 1908 (2, U.S.N.M., 34866).

Albatross station 5153; Tawi Tawi group; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5° 18′ 10″ N., long. 12° 02′ 55″ E.); 89 meters; coral sand and shells; February 19, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34955).

Siboga station 93; Pulu Sanguisiapo, Tawi Tawi group; 12 meters; lithothamnion, sand and coral; June 24–25, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Albatross station 5147; near Siasi, Jolo (Sulu) archipelago; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908] (5, U.S.N.M., 34906, 34907, 34913).

Albatross station 5136; in the vicinity of Jolo; Jolo light bearing S. 37° E., 0.7 mile distant (lat. 6° 04′ 20″ N., long. 120° 59′ 20″ E.); 40 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908] (7, U.S.N.M., 34929).

Albatross station 5137; in the vicinity of Jolo, Jolo light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908] (8, U.S.N.M., 34910, 34934, 34954).

Albatross station 5138; in the vicinity of Jolo; Jolo light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 35 meters; sand and coral; February 14, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 34905).

Albatross station 5139; in the vicinity of Jolo; Jolo light bearing S. 51° W., 3.6 miles distant (lat. 6° 06′ 00″ N., long. 121° 02′ 30″ E.); 36 meters; coral sand; February 14, 1908 [A. H. Clark, 1908] (14, U.S.N.M., 34839, 34909, 34952, 34957, 36182). Pl. 14, figs. 35, 36.

Albatross station 5142; in the vicinity of Jolo; Jolo light bearing S. 50° W. 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34911).

Siboga station 99; anchorage off North Ubian (lat. 6° 07′ 30″ N., long. 120° 26′ 00″ E.); 16–23 meters; lithothamnion bottom; June 28–30, 1899 [A. H. Clark, 1918] (10, Amsterdam Mus.).

Albatross station 5141; in the vicinity of Jolo; Jolo light bearing S. 17° E., 5.5 miles distant (lat. 6° 09′ 00″ N., long. 120° 58′ 00″ E.); 53 meters; coral sand; February 15, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34912).

Challenger station 212; off Zamboanga, Philippines (lat. 6° 54′ N., long. 122° 18′ E.); 18 meters; sand; January 30, 1875 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Albatross station 5249; Gulf of Davao; Lanang Point bearing N., 1.0 mile distant (lat. 7° 06′ 06″ N., long. 125° 40′ 08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909, 1911] (2, U.S.N.M., 34865, 35710).

Albatross station 5355; North Balabac Strait; Balabac light bearing S. 61° W., 16.6 miles distant (lat. 8° 08′ 10″ N., long. 117° 19′ 15″ E.); 80 meters; coral and sand; January 5, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35709).

Bantayan reef, Cebu, Philippines (1, M. C. Z., 384).

Bohol, Philippines [von Graff, 1884].

Albatross station 5482; in the vicinity of Surigao Strait, between Samar and Leyte; Cabugan Grande Island (N.) bearing 87° W., 4.5 miles distant (lat. 10° 27′ 30″ N., long. 125° 18′ 00″ E.); 122 meters; broken shells, sand, and green mud; July 30, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 34851).

Albatross station 5483; between Samar and Leyte; Cabugan Grande Island (N.) bearing N. 88° W., 5.7 miles distant (lat. 10° 27′ 30″ N., long. 125° 19′ 15″ E.); 135 meters; sand and broken shells; July 30, 1909 (1, U.S.N.M., 34838).

Albatross station 5205; off the eastern coast of Leyte; Caguayan Point bearing N. 2° E., 0.7 mile distant (lat. 11° 19′ 30″ N., long. 124° 58′ 05″ E.); 15 meters; April 13, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34853).

Challenger station 208; off Panay (lat. 11° 37′ N., long. 123° 31′ E.); 33 meters; blue mud; January 17, 1875 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Port Galera, Mindoro; Laurence E. Griffin [H. L. Clark, 1921] (20, M. C. Z., 626–628, 648–654, 657, 658).

Albatross station 5276; China Sea, in the vicinity of southern Luzon; Malavatuan Island (NW.) bearing N. 61° 30′ E., 6.5 miles distant (lat. 13° 49′ 15″ N., long. 120° 14′ 45″ E.); 33 meters; shells, pebbles, and sand; July 17, 1908 [A. H. Clark, 1911] (2, U.S.N.M. 34856, 34902).

Albatross; Philippine Islands, 1907–1910 [A. H. Clark, 1908] (4, U.S.N.M., 34948).

Macclesfield Bank; 40–55 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.)

Macclesfield Bank; 40–82 meters [Bell, 1894].

Macclesfield Bank; 42–73 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Macclesfield Bank; 55–73 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Macclesfield Bank; 82 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

China Sea [P. H. Carpenter, 1888; Hartlaub, 1891].

?China [A. H. Clark, 1912] (1, Berl. M., 5285).

Formosa (Taiwan) [Hartlaub, 1891; A. H. Clark, 1912] (1, H. M.).

Siboga station 33; Bay of Pidjot, Lombok; 22 meters and less; mud, coral, and coral sand; March 24–26, 1899 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 40; anchorage off Pula Kawassang, Paternoster Islands; coral reef; April 2, 1899 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 37; Sailus ketjil, Paternoster Islands; 27 meters and less; coral and coral sand; March 30–31, 1899 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 47; Bay of Bima, Sumbava, near south fort; 55 meters; mud, with patches of fine coral sand; April 8–12, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 451).

Siboga station 49*a*; Sapeh Strait (lat. 8° 23′ 30″ S., long. 119° 04′ 36″ E.); 69 meters; coral and shells; April 14, 1899 [A. H. Clark, 1918] (5, U.S.N.M., E. 458; Amsterdam M.).

Siboga station 50; Bay of Badjo, western coast of Flores; down to 40 meters; mud, sand, or shells according to locality; April 16–18, 1899 [A. H. Clark, 1918] (3, Amsterdam M.).

Siboga station 299; Buka or Cyrus Bay, southern coast of Rotti; 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 60; Haingsisi, Samau Island; reef; lithothamnion in 3 meters and less; April 27–28, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 487).

Siboga station 294; off southwestern Timor (lat. 10° 12′ 12″ S., long. 124° 27′ 18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1918] (4, Amsterdam M.).

Siboga station 296; anchorage off Noimini, southern coast of Timor; coral reef; January 24–26, 1900 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 285; anchorage on the southern coast of Timor (lat. 8° 39′ 06″ S., long. 127° 04′ 24″ E.); 34 meters; on the border between coral and mud; January 18, 1900 [A. H. Clark, 1918] (1, Amsterdam M.)

Siboga station 144; anchorage north of Salomakieë (Damar) Island; 45 meters; coral and lithothamnion; July 7–9, 1899 [A. H. Clark, 1918] (2, Amsterdam M.).

Ternate, Moluccas [Pfeffer, 1900; A. H. Clark, 1912] (2, H. M.).

Amboina; Professor von Martens [P. H. Carpenter, 1888; A. H. Clark, 1912] (1, Berl. M.).

Amboina; Prof. Dr. J. Brock [Hartlaub, 1891].

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; breakwater; about 1 meter; February 28, 1922 (3).

Danish Expendition to the Kei Islands; Dr. Th. Mortensen; Amboina; about 2 meters; stony bottom; February 9, 1922 (1).

Danish Expendition to the Kei Islands; Dr. Th. Mortensen; Banda; off Neira; 13 meters; sand; June 12, 1922 (1); about 15 meters; sand; June 9, 1922 (5); about 20 meters; sand; June 1, 1922 (8); about 25 meters; sand; June 14, 1922 (1); Lontor; 25 meters; stony bottom; June 11, 1922 (1). Pl. 11, fig. 30.

Banda; *Challenger* [P. H. Carpenter, 1888; A. H. Clark, 1913] (2, B. M.).

Banda; 31 meters; *Challenger* [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Siboga station 240; Banda; 9–36 meters; black sand; coral; lithothamnion bank; November 22 to December 1, 1899 [A. H. Clark, 1918] (2, Amsterdam M.).

Siboga station 162; western coast of Salawatti, between Loslos and Broken Islands; 18 meters; coarse and fine sand; August 18, 1899 [A. H. Clark, 1918] (2, Amsterdam M.).

Siboga station 250; anchorage off Kilsuin, western coast of Kur Island; 20–45 meters; coral and lithothamnion; December 6–7, 1899 [A. H. Clark, 1918] (1, Amsterdam M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 11; 20 meters; sand; April 9, 1922 (1); station 14; about 40 meters; sand; April 10, 1922 (3); station 15; about 5 meters; sand and lithothamnion; April 10, 1922 (1); station 20; about 50 meters; sand and shells; April 14, 1922 (3); station 21; 50–70 meters; hard bottom; April 14, 1922 (2); station 24; 100 meters; hard bottom; April 15, 1922 (1); station 26; about 90 meters; sand; April 16, 1922 (3); station 27; 60–70 meters; April 17, 1922 (1); station 30; about 40 meters; sand and shells; April 18, 1922 (5) [Pl. 13, fig. 34]; station 31; about 50 meters; sand; April 18, 1922 (4); station 38; about 35 meters; sand; April 24, 1922 (4); station 40; about 20 meters; sand; April 25, 1922 (1); station 53; 85 meters; sand; May 8, 1922 (1); station 54; 85 meters; sand and coral; May 9, 1922 (3).

Aru Islands, off Pulu Bambu; 10 meters; rocky bottom, with sand and coral; April 3, 1908 [Reichensperger, 1913].

Siboga station 274; northeast of the Aru Islands (lat. 5° 28′ 12″ S., long. 134° 53′ 54″ E.); 57 meters; sand and shells; stones; December 26, 1899 [A. H. Clark, 1918] (1, Amsterdam M.).

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands; 20–45 meters; pearl banks; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (6, U.S.N.M., E. 483; Amsterdam M.).

Australian Seas; Péron and Lesueur [Lamarck, 1816; J. Müller, 1849; P. H. Carpenter, 1888].

Between Fremantle and Geraldton, Western Australia; *Endeavour* [A. H. Clark, 1914] (3, U.S.N.M., 34868; W. A. Mus. and Art Gallery).

Turtle Bay, Dirk Hartog Island, Western Australia; 13 meters; *Gazelle* [A. H. Clark, 1909, 1912] (1, Berl. M., 3432).

Gazelle; north of Port Walcott, Western Australia (lat. 19° 42′ 06″ S., long. 116° 49′ 48″ E.); 91.5 meters [Studer, 1899].

Mjöberg's station 1; Cape Jaubert, Western Australia, 42 miles westsouthwest; 21 meters; May 29, 1911 [Gislén, 1919, 1922].

Northwestern Australia [Bell, 1894; A. H. Clark, 1913] (3, B. M.).

Challenger station 186; Prince of Wales Channel, Torres Strait (lat. 10° 30′ S., long. 142° 18′ E.); 15 meters; coral mud; September 8, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Mer, Murray Islands, Torres Strait; about 9–11 meters [H. L. Clark, 1915, 1921].

Mer, just outside the southern reef; 5–9 meters (1, M. C. Z., 508).

Claremont Islands, Queensland (about lat. 14° S.); 20 meters; sand and mud; *Alert* [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Flinders Islands, Queensland (west of Cape Melville) [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (?1, B. M.).

Lizard Island, Queensland (north of Cooktown); 15 meters [A. H. Clark, 1913, as Tizaid reef] (1, B. M.).

Lizard Island; 49 meters [A. H. Clark, 1913, as Tizaid reef] (1, B. M.).

Blanche Bay, New Britain; Prof. Arthur Willey [A. H. Clark, 1913] (1, B. M.).

Ekalin, St. Matthias Island, Bismarck archipelago; Dr. G. Duncker [A. H. Clark, 1912] (1, H. M.).

St. Matthias Island; Herr H. Schöde [A. H. Clark, 1912] (1, Berl. M., 5941).

Ruk, Caroline Islands [Hartlaub, 1891; A. H. Clark, 1912] (1, H. M.).

East Indies [Lütken, 1871].

Indian Seas [Linné, 1758; Retzius, 1783, 1805; J. Müller, 1843; P. H. Carpenter, 1888].

"Antarctic Expedition" [A. H. Clark, 1913] (1, B. M.).

No locality [A. H. Clark, 1912, 1913] (4, B. M.; Berl. M.).

Geographical range.—From the Maldive Islands and Ceylon eastward to Formosa (Taiwan), the Philippines, and the Caroline Islands, and southward to Australia, reaching Cape Flattery (lat. 15° S.) on the east coast and Shark Bay on the west.

Bathymetrical range.—From the shore line down to 292 meters; nearly half of the records are from the shore line, and only 6 out of 111 are from water more than 100 meters in depth. The average of the 111 records is 38 meters.

Thermal range.—One record, 25.56° C.

History.—This species was first noticed by Petiver who in 1716 figured a specimen with 13 arms under the name of *Stella chinensis perelegans dupliciter radiata.*

Link in 1733 created a special genus, Τρισκαιδεκάκνημος, for Petiver's specimen which, however, he suspected had been mutilated.

In 1758 Linné referred this specimen to his *Asterias pectinata*, placing the reference to Petiver's figure among the four synonyms of this species. *Asterias pectinata* he described as "A. radiata radiis duplicatis: superioribus pinnatis, inferioribus filiformibus." As synonyms he cites the forms described by Barrelier (=*Antedon mediterranea*), Columna (=*Antedon mediterranea*), Petiver (=*Capillaster multiradiata*) and Link (=*Antedon bifida* and *A. mediterranea*).

While it is clear that Linné intended to bestow the name *pectinata* upon the common comatulid of the European coasts (*Antedon*), he gave as the habitat for his *Asterias pectinata* "in M. Indico." Of the specimens described by previous authors which he referred to *pectinata* one was from China and all the rest from European seas, one being from England and the remainder from the Mediterranean; none of them had come from India. This discrepancy is explained by the existence of a specimen at Lund which he had before him when he wrote the account of *pectinata*. This specimen represents the species now known as *Comatula pectinata.*

Immediately following Linné's description of *Asterias pectinata* is his description of *Asterias multiradiata.* This he says is "A. radiata radiis palmato-multiplicatis pinnatis: inferioribus filiformibus." As references he cites Linck's *Caput-Medusae cinereum* and *C.-M. brunnum;* the habita the gives as "in M. indico." He adds that this species is close to *A. pectinata,* if not merely a variety of it.

This description of *Asterias multiradiata* was based on a specimen at Lund which was redescribed by Retzius in 1783 and again in 1805.

Under the name of *Comatula multiradiata* Lamarck in 1816 referred to three specimens in the Paris Museum which had been brought by Péron and Lesueur from the Moluccas in 1803. These I examined in 1910. One of them is an example of *Capillaster sentosa,* another is an example of *Comanthus bennetti,* and the third served as the basis for J. Müller's redescription of the *multiradiata* of Lamarck (not of Linné) under the name of *Alecto multifida* (1841).

At the same time Lamarck described under the name of *Comatula fimbriata* another specimen which had been brought from Australian seas by Péron and Lesueur.

In 1843 J. Müller redescribed the Linnean type of *Asterias multiradiata* which he had examined at Lund. He says that the centrodorsal is flat, sunken in the middle. The cirri are XXIV, 24; the cirrus segments are not longer than broad; on the younger a few segments are longer than broad, on the older the segments are often broader than long. The radials are concealed. The elements of the IBr series are short. The IIBr series are 4 (3+4), and the IIIBr series are 3 (2+3). The brachials are short with the distal edge bordered with fine spines. The intersyzygial interval is from 8 to 15 muscular articulations. The pinnules at the bases of the arms are the largest. The pinnule segments are short. The disk bears many calcareous nodules resembling pinheads.

At the same time he redescribed the Lamarckian type of *Comatula fimbriata.* The cirri are XV, 22; the 8 outermost cirrus segments bear a small sharp dorsal spine. There are 17 arms. The IIBr series are 4 (3+4). The IIIBr series are 3 (2+3). The brachial intersyzygial interval is from 7 to 10, sometimes even 13, muscular articulations. The pinnules are all of approximately the same length. The size is 6 inches.

In 1849 Müller redescribed *Comatula* (*Alecto*) *fimbriata* in the following terms: Twenty arms. The centrodorsal is free of cirri in the middle with the dorsal pole flat. The cirri are XV, 22, marginal in position; toward the end of the cirri the segments gradually develop small blunt spines. IIBr series 4 (3+4). The lowest pinnule (P_D) is on the $IIBr_2$, but the first pinnule of the undivided arms (P_1) is on the first brachial while the second and third brachials are united by syzygy. Beyond the arm base syzygies occur at intervals of from 6 to 10 muscular articulations. The brachials have the distal edge very rough except at the syzygial lines. P_D is the largest pinnule. The ventral surface of the disk bears a few scattered concretions. The color is yellow. The size is nearly 8 inches.

Müller says that the specimen described is an alcoholic example in the Paris Museum which was brought from Trinquemale, Ceylon, by Reynaud in 1829. He mentions another specimen, dry, in the same museum from the voyage of Péron and Lesueur which was labeled *Comatula multiradiata* Lam.

Müller redescription of the Lamarckian type of *Comatula fimbriata* published in 1843 was drawn up from notes on the specimen taken for him by Troschel, but in

1844 he himself visited the Paris Museum and the redescription of the species published in 1849 was the result of his own personal studies.

In Müller's redescription of *Comatula* (*Alecto*) *multiradiata* published in 1849 he gives the number of arms as 40–50 and the cirri as XXIV, 24–30. The specimens upon which this redescription was based are: (1) The Linnean type at Lund; (2) a dry specimen in the Paris Museum collected by Péron and Lesueur which was also mentioned under *Comatula* (*Alecto*) *fimbriata;* (3) an alcoholic specimen from the Moluccas in the Paris Museum collected by Péron and Lesueur in 1803, with exactly 40 arms; and (4) an alcoholic specimen from the Moluccas in the Paris Museum collected by Quoy and Gaimard with about 50 arms. These two last were both included in *Comatula multiradiata* by Lamarck in 1816; they represent the species now known as *Capillaster sentosa.*

The description of *Comatula fimbriata* published by Dujardin and Hupé in 1862 is a translation of Müller's redescription of 1843, the only change being that the number of arms is given as 17–25.

The authors add a note saying that Lamarck, who seems to have confused at least two species, states that the arms, which are scarcely 81 mm. long, are more slender than those of *Comatula rotalaria*, 12–30 in number, with the brachials slightly spinous on the edge.

Dujardin and Hupé's account of *Actinometra multiradiata* is a translation of Müller's description of 1843. No habitat is given for it.

In 1874 Lütken, under the name of *Actinometra gracilis*, listed a specimen of this species from Formosa (Taiwan).

In 1875 Grube described as *Comatula* (*Actinometra*) *borneensis* a specimen from North Borneo.

P. H. Carpenter in 1876 and 1877 published notes on certain points in the structure and anatomy of this form based on specimens which had been collected by Semper in the Philippines, and in 1877 Prof. Ludwig von Graff described the myzostomes from specimens in the Semper collection from Bohol in the Philippines.

Carpenter visited the Paris Museum in 1876 and studied the specimens which had been described by Lamarck and by Müller. The results of this study he published in 1879. He remarked, as had Müller, that the dry specimen which had served Lamarck as the type of *Comatula fimbriata* and which had been brought from Australia by Péron and Lesueur was labeled *Comatula multiradiata* Lam., while Reynaud's specimens he found bearing the name *Comatula brevicirra* Troschel and labeled as having come from the Sunda Strait. He mentioned that he found the name *Comatula brevicirra* associated also with the type of *Comatula solaris*, with *C. rotalaria*, and with some specimens of *Comanthus parvicirra* from Vavao.

In 1882 Carpenter summarised the information on this species and published a careful redescription of it. This redescription, however, was based upon 2 specimens collected by the *Challenger* at Banda and upon notes taken at Paris on another brought from the Moluccas by Quoy and Gaimard; all three of these belong to the form now known as *Capillaster sentosa.* He mentioned some fragments of a dried specimen from Sumatra in the Hamburg Museum, as well as Lamarck's type of *fimbriata* at Paris and Linné's type of *multiradiata* at Lund, giving notes on all three.

In 1884 Carpenter emphasized the anomalous position of the first brachial syzygy in this species, and cited *Actinometra multiradiata* as typical of a group of several species of "*Actinometra*" which together make up the "Group of *Actinometra multiradiata*," one of the 8 groups into which he tentatively divided the genus *Actinometra* as understood by him.

Under the name of *Actinometra coppingeri* Prof. F. Jeffrey Bell in 1884 described a new comasterid from northeastern Australia which has since proved to be this species. As described by him, however, the first brachial syzygy is between brachials 3+4. The generalized and more or less schematic figure was evidently drawn more from the description than from the specimen, as the position of the syzygies agrees wholly with that given in the former and not at all with what actually is found in the latter.

In 1888 Carpenter defined the group including *multiradiata*, but called it the "*Fimbriata* group" instead of the "group of *Actinometra multiradiata*" as he had in 1884. In this group he recognized 7 species, *fimbriata, coppingeri, borneensis, multiradiata, sentosa, lineata*, and *discoidea*, the last two being from the western Atlantic.

He considered that the possesssion of short and discoidal brachials differentiated *fimbriata* from the other species. The Indo-Pacific forms with shortly triangular brachials becoming more quadrate or discoidal distally he separated into two groups based on the presence or absence of IIIBr series. The two forms without IIIBr series were separated on the occurrence of less than 24 cirrus segments (*coppingeri*), or more than 24 cirrus segments (*borneensis*). The two with IIIBr series were separated on the occurrence of less than 30 cirrus segments and no IVBr series (*multiradiata*), or the possession of more than 30 cirrus segments and the presence of IVBr series resembling the IIIBr series (*sentosa*).

He described *fimbriata* in detail and assigned to it 3 specimens collected by the *Challenger* at Banda, 1 from *Challenger* station 208, and others which he had examined from "Sunda Strait (Regnault)," the Australian Seas, "Angio, Java," the Nicobar Islands, and Madagascar (the last *coccodistoma*).

An examination of the type of *coppingeri* at the British Museum had shown him that Bell's description and figure were incorrect. On the strength of these he had originally assigned *coppingeri* to a place in the *Parvicirra* group and had called the type actually represented by it *stewarti*. He redescribed the form on the basis of all the available material and assigned to it specimens collected by the *Challenger* at Banda and at Zamboanga, and others which he had seen from Singapore, Amboina, and the China Sea. He compared *coppingeri* with Grube's *borneensis*, which last was the only comasterid the type specimen of which he had not seen, and which seems to have been lost.

He also described *multiradiata* in detail on the basis of such specimens as he was able to examine, and gave a detailed historical account of it. To this form he referred specimens from the Indian Seas (the type specimen), the Australian Seas, Sumatra, Bohol, the China Sea, and Kagoshima Bay, Japan (the last being *mariae*).

His description of *sentosa* was practically identical with the description of *multiradiata* which he had published in 1882.

In 1888 Prof. F. Jeffrey Bell listed *Actinometra parvicirra* as inhabiting the Bay of Bengal, the record being based upon specimens sent to the British Museum by Mr. Edgar Thurston, of the Madras Government Museum. Examination of the material in London in 1910 showed that two of these specimens are in reality *multiradiata*.

In 1889 Prof. Th. Studer recorded this species from two localities in Western Australia where it had been dredged by the German steamer *Gazelle*.

Dr. Clemens Hartlaub in 1891 reviewed the *Fimbriata* group of *Actinometra*. To it he assigned 8 species, 1 (*discoidea*) from the Caribbean islands, 1 (*lineata*) from Brazil, and the other 6 from the Indian archipelago and the China Sea.

Under the name of *Actinometra coppingeri* he described a specimen which had been collected by Prof. J. Brock at Amboina in 1884–85. To *Actinometra fimbriata* he referred a very remarkable specimen from Ruk in the Carolines which he found in the Hamburg Museum. As *Actinometra multiradiata* he recorded 5 specimens from the China Sea in the Göttingen Museum, and another from Formosa (Taiwan) which he found in the Hamburg Museum bearing the manuscript name *Actinometra gracilis* of Lütken. As *Actinometra multiradiata* he also described a specimen from Kagoshima, Japan, which is referable to *mariae*.

In 1894 Mr. Edgar Thurston published a few notes on the occurrence and habits of a few comatulids found in shallow water on the coast of the Madras Presidency in India. His specimens had been identified by Bell, and on examining them in London I found an example of this species among those determined as [*Comanthus*] *parvicirra*.

Professor Bell in 1894 recorded this species (as *multiradiata* and as *fimbriata*) from northwestern Australia. He mentioned the chief localities where collections had been made, but did not segregate the species according to locality. Prof. René Koehler in 1895 recorded *multiradiata* from Billiton where it had been collected by M. Korotnev, Prof. Georg Pfeffer recorded it (as *coppingeri* and as *fimbriata*) from Ternate in 1900, and in 1902 Professor Bell recorded it (as *fimbriata*) from the Maldives. In 1904 Mr. Herbert Clifton Chadwick recorded it from four stations about Ceylon.

In February, 1908, the present author in a revision of the comasterids referred this species (as *borneensis*, *coppingeri*, *fimbriata*, and *multiradiata*) to the genus *Comaster*. In October, 1908, in a paper on the brachial homologies in the recent crinoids he redefined *Comaster* on the basis of the characters exhibited by the arm divisions and referred to it all the described forms now included, as species or as synonyms, in the genus *Capillaster*.

In December, 1908, the author recorded this species (as *fimbriata* and as *coppingeri*) from a number of localities in the Philippines where it had recently been dredged by the United States Fisheries steamer *Albatross*.

In April, 1909, the author published a note in which he showed that the generic name *Comaster* is not available for the species of this general group, and for them he therefore suggested *Capillaster*, with the genotpye *Actinometra sentosa* P. H. Carpenter, 1888.

In May, 1909, the author recorded the species from additional *Albatross* stations in the Philippines and stated that "A critical study of a very large series shows that

Comatula fimbriata, *Actinometra borneensis*, and *Actinometra coppingeri* should all be referred to the Linnean *Asterias multiradiata*." In June, 1909, he published a detailed account of a curious specimen which had been dredged by the *Gazelle* at Dirk Hartog Island, and which had been mentioned without comment by Studer in 1889. Later in the same month in a revision of the comasterids he described under the name of *Comissia lütkeni* the two 10-armed specimens which in December, 1908, he had recorded, with others, as *Comaster coppingeri*.

In November, 1909, he published a detailed account of the specimens of this species in the Zoological Museum at Copenhagen, with a synonymy and historical and other notes.

In February, 1911, he recorded this form from 4 additional *Albatross* stations in the Philippines; later in the same year he mentioned having examined the 3 specimens from the Sunda Straits in the Paris Museum, and recorded another from the Java Sea which he had seen in the Leyden Museum.

In 1911 the occurrence of this species on the Australian coasts was discussed in detail in two different papers, but no new records were given.

In 1912 specimens in the Berlin Museum from 7 different localities, only one of which had previously been noted, were recorded, as well as others from 5 localities, only one of which was previously mentioned, in the collection of the Hamburg Museum.

In his monograph on the crinoids of the Indian Ocean published in 1912 the author gave a detailed account of this species, with a complete synonymy, and added many new localities, most of them resulting from the operations of the Royal Indian Marine Surveying steamer *Investigator*. In the same year Hartlaub recorded as ?*Actinometra fimbriata* an arm fragment from the Sooloo (Jolo) Islands which had been brought back by the United States Exploring Expedition, and Professors Koehler and Vaney discussed the gastropod parasite which had been found by the author on a specimen from Singapore and described in an appendix to his paper on the crinoids of the Zoological Museum at Copenhagen published in 1909.

In 1913 Dr. August Reichensperger, in an account of a collection of comatulids from the Aru and Kei Islands made by Dr. H. Merton in 1907–8, recorded four specimens of this species from Ceylon which had been collected by Doctor Sarasin in 1886, and described in detail under the name of *Capillaster clarki* two from the Aru Islands.

In 1913 the author published notes on the 21 lots of specimens which he had studied in the British Museum in 1910, giving references to the original records in all cases where the specimens previously had been mentioned.

In 1913 the author outlined the range of this species in eastern Asia, giving it as occurring in the China Sea and at Formosa (Taiwan), and in the same year Professors Koehler and Vaney discussed the history and affinities of the gastropod parasite.

In 1914 the author recorded it from the coast of Western Australia, where it had been dredged by the *Endeavour*, and Prof. Frank W. Clarke and William C. Wheeler published a chemical analysis of the skeleton which had been made at the request of the author.

In 1915 in a paper on the distribution of the Australian crinoids the range of this form in the Australian seas was given in detail, and later in the same year it was classed as a Malayan type. On the basis of previous records it was listed by Dr. Hubert Lyman Clark in 1915 as among the echinoderms of Ceylon.

In 1915 Dr. Hubert Lyman Clark published an account of a specimen which he had collected at Maër Island in Torres Strait in 1913, and in 1916 Dr. Robert Hartmeyer published a correction of a catalogue number on one of the specimens in the Berlin Museum which had been recorded by the author in 1912.

In the author's report upon the unstalked crinoids of the *Siboga* expedition published in 1918 a detailed account of all the specimens referable to this species was given, and many new localities were added to the known range. In 1921 Dr. H. L. Clark discussed the distribution of this species on the coasts of Australia in great detail.

The specimen of *Comaster multifida* from Mjöberg's station 1 described and figured by Gislén in 1919, and reidentified by him in 1922 as *Comanthus parvicirra*, was in reality a young and more or less aberrant example of this species.

CAPILLASTER TENUICIRRA A. H. Clark

Plate 15, Figure 37

Capillaster tenuicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (description; *Siboga* Station 320); Unstalked Crinoids of the *Siboga* Exped., 1918, p. VIII (discovery by the *Siboga* and its significance); p. 10 (in key; range); p. 12 (synonymy; detailed description; Stations 166, 318, 319, 320); pp. 273, 276 (listed); pl. 12, fig. 6.

Diagnostic features.—Except for the elongated and slender cirri in which the distal segments from the tenth or eleventh onward are very slightly longer than broad, this species resembles *C. multiradiata*. The arms are 14–32 (usually 20–25) in number, and the cirri are XII, 24–30.

Description of a specimen from Siboga station 166.—The centrodorsal is thick discoidal, rather small, with the bare polar area flat, 3 mm. in diameter. The cirrus sockets are arranged in a single irregular marginal row.

The cirri are XII, 24–27, 25 mm. long. The first segment is very short, the second and third are about twice as broad as the ventral length, the fourth is half again as long as broad, the fifth is twice as long as broad, the sixth resembles the fifth, and those following gradually decrease in length so that the tenth or eleventh and those following are very slightly longer than broad. The sixth is a transition segment. The cirri taper slightly from the base to the middle of the transition segment, from that point onward being more slender and highly polished. From the transition segment onward the segments have the distal dorsal edge slightly everted, forming a low and inconspicuous transverse ridge just within the distal dorsal border which is narrowly crescentic in end view, never becoming pointed. This is so low as to be almost imperceptible in lateral view, so that the cirri superficially appear quite smooth. The opposing spine is very small, terminal. The terminal claw is slightly longer than the penultimate segment, moderately slender and moderately and evenly curved.

The ends of the basal rays are just visible in the angles of the calyx, bridging over the narrow subradial clefts.

The IBr_1 are very narrow, trapezoidal, about five times as broad as long, entirely united laterally. The IBr_2 (axillaries) are very broadly pentagonal, twice as broad as long, free laterally. The IIBr series are 4 (3+4).

There are 20 arms 110 mm. long. One of the IIBr series is absent, but a IIBr 2 series (the only IIBr series not 4 [3+4]) bears a IIIBr 2 series internally. The brachials resemble those in young individuals of *C. multiradiata;* the more proximal are obliquely wedge-shaped, almost triangular, from half again to twice as broad as long. The distal edges of the brachials are slightly produced and are armed with numerous short fine spines.

Syzygies occur between brachials 2+3, 13+14 to 30+31, usually in the vicinity of the fifteenth brachial, and distally at intervals of from 4 to 8 (usually 7) muscular articulations.

The dorsal and lateral surfaces of the arms and division series are thickly beset with very fine spines which are rather more prominent on the lateral surfaces.

P_D is 15 mm. long, comparatively slender, and is composed of 30 segments; the comb, which resembles that of *C. multiradiata*, consists of from 7 to 9 well-developed and 3 or 4 rudimentary teeth. P_1 is 14 mm. long, similar to P_D, but slightly more slender. P_2 is 13 mm. long, similar to P_1. P_3 is 10 mm. long, resembling the pinnules preceding. P_4 is 8 mm. long, with a comb. Combs occur at intervals to the end of the proximal half of the arm.

The mouth is radial and submarginal. The anal tube is central. The perisome of the disk is naked.

Notes.—Another specimen from *Siboga* station 166 has 14 arms 100 mm. long and the cirri XVI, 28–30, 28 mm. long. On some of the cirri the outermost segments bear dorsally a transverse ridge with a small but distinct spine in the center. One of the IIBr series is 2, the remainder being 4 (3+4).

Of the 14 specimens from *Siboga* station 318, one has 10 arms, two have 11, three have 12, one has 13, one has 15, three have 16, one has 23, one has 25, and one has 30. The largest and best developed example has 25 arms 125 mm. long; the cirri are from 35 to 40 mm. long. The arms borne by the 5 rays are 4, 4, 3, 3, 11; the right posterior ray bears a IBr series ending in a trapezoidal ossicle from which 4 arms are given off, 2, side by side, from its distal (longest) face, and 1 from each of the lateral faces; this segment represents 2 normal IIBr axillaries (with their derivatives) fused, and there is a faintly indicated median dividing line. Another large individual has 23 arms 125 mm. long; of the 9 IIBr series one is 2, one is 1, and the others are 4 (3+4); the IIIBr series are all internally developed.

The specimen from *Siboga* station 319 has 32 arms 85 mm. long; on every ray one of the derivatives from the IBr axillary remains undivided, so that 27 of the arms are borne on 5 IIBr series.

Of the specimens from *Siboga* station 320, two have 10 arms, two have 12, two have 13, two have 14, one has 17, one has 18, two have 21, two have 22, one has 23, and one has 28. One of the two with 21 arms has the anterior and right anterior rays only about half the size of the others, with 4 and 5 arms, respectively; there are 3 IIIBr series; the arms are robust. The other with 21 arms has the arms distributed on the various rays as follows: 2, 5 (4+1); 5 (1+4); 4 (1+3); 5 (4+1); one of the IIBr series is 3 (2+3), the other three being 4 (3+4); all of the IIIBr series are 3 (2+3); only a single cirrus is present, the centrodorsal approaching the condition of a sunken stellate plate. One of the specimens with 22 arms has the arms 130 mm. long; one of the IBr series bears two undivided arms, and three others have one divided and one undivided derivative. There are 4 internally developed IIIBr series, and 2 IIIBr series on a single IIBr series; the only external IIIBr series is 2 instead of, as the others, 3 (2+3). The other example with 22 arms has the 2 posterior rays and their derivatives less than half the size of the remainder; there are 3 IIIBr series, all internal and all 3 (2+3). The specimen with 23 arms has the right anterior ray and its derivatives very small, and the anterior of about the same size; the left anterior is slightly larger, and the two posterior are normal. All of the small rays bear 4 arms each, the right anterior and the anterior carrying 2 IIBr 2 series, and the left anterior 2 IIBr 4 (3+4) series; the IIIBr series are internal. The example with 18 arms has 4 of the IIBr series 2, and four 4 (3+4). The specimen with 17 arms has one ray with only IBr series, and on another ray an undivided arm springing from a IBr axillary. One of the specimens with 13 arms has on one ray two IIBr 2 series, one of which bears externally a IIIBr 3 (2+3) series. The other has one IIIBr series. One of those with 14 arms has 3 IIIBr series, two of which are on a single IIBr series, while the other is externally developed. One of the 12-armed individuals has one of the IIBr series 2 and the other 4 (3+4); one of the 10-armed examples is of mature size.

The specimen from *Siboga* station 322 is large, with 16 arms 125 mm. long; the cirri are rather small and slender, XVI, 21, from 15 to 17 mm. long.

Extraordinary variability appears to be characteristic of this form. The arms vary from 10 to 32 in number. The cirri are usually very slender, with the distal segments longer than broad and bearing single dorsal spines, but they may be stouter, with the distal segments not longer than broad, in which case they bear two dorsal spines, a distal and a proximal.

Abnormalities.—In one of the specimens from *Siboga* station 320, only a single cirrus is present, the centrodorsal approaching the condition of a sunken stellate plate.

In a specimen from *Siboga* station 166 some of the cirri have the outermost segments bearing dorsally a transverse ridge, with a small but distinct spine in the center.

In another specimen from *Siboga* station 166 one of the IIBr series is 2; in another from *Siboga* station 318 one of the IIBr series is 2; in an example from *Siboga* station 320 there are four IIBr 2 series and two IIBr 4 (3+4) series; another from the same station has four IIBr 2 and four IIBr 4 (3+4) series; in a third the only two IIBr series present are 2; while in a fourth there is one IIBr 2 series and one IIBr 4 (3+4) series.

In a specimen from *Siboga* station 318 one of the IIBr series is 1.

In an example from *Siboga* station 320 one of the IIBr series is 3 (2+3).

In one of the specimens from *Siboga* station 318 one of the IBr series terminates in a trapezoidal ossicle bearing 4 arms.

A IIIBr 2 series, internally developed, is borne on a IIBr 2 series in a specimen from *Siboga* station 166; an externally developed IIIBr 2 series occurs in an individual from *Siboga* station 320.

In one of the specimens from *Siboga* station 320 the anterior and right anterior rays are dwarfed; in another from the same station the 2 posterior rays are dwarfed; while in a third the right anterior, anterior, and left anterior rays are dwarfed.

Localities.—*Siboga* station 320; Java Sea, north of Madoera (lat. 6° 05′ 00″ S., long. 114° 07′ 00″ E.); 82 meters; fine gray mud; February 23, 1900 [A. H. Clark, 1912, 1918] (16, Amsterdam Mus.). Pl. 15, fig. 37.

Siboga station 319; Java Sea, north of Madoera (lat. 6° 16′ 30″ S., long. 114° 37′ 00″ E.); 82 meters; fine yellowish gray mud; February 22, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 318; Java Sea, northeast of Madoera (lat. 6° 36′ 30″ S., long. 114° 55′ 30″ E.); 88 meters; fine yellowish gray mud; February 22, 1900 [A. H. Clark, 1918] (14, Amsterdam Mus.).

Siboga station 166; off the northeastern coast of Ceram (lat. 2° 28′ 30″ S., long. 131° 03′ 18″ E.); 118 meters; hard coarse sand; August 22, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Geographical Range.—Java Sea and the coast of Ceram.

Bathymetrical range.—From 82 to 118 meters. The average of 4 records is 92 meters.

Remarks.—The only known specimens of this curious form are those which were dredged by the *Siboga* in 1899 and 1900.

CAPILLASTER COCCODISTOMA (P. H. Carpenter)

Comotula coccodistoma Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 208 (listed; *nomen nudum*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 320 (Madagascar; *nomen nudum*).—A. H. Clark, Bull. du mus. d'hist. nat. de Paris, 1911, No. 4, p. 245 (=*Capillaster coccodistoma*+*Comanthus wahlbergii*).

Actinometra coccodistoma P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula).

Actinometra fimbriata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 317 (?Madagascar).—Ludwig, Abhandl. Senck. naturf. Gesellsch., vol. 21, Heft 4, 1899, p. 539 (recorded from ?Madagascar by Carpenter).

Capillaster multiradiata A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast coast of Africa); p. 13 (southeast Africa); p. 16 (Madagascar; Cape St. André, Madagascar; description of specimens).

Capillaster multiradiata var. *coccodistoma* A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 16 (varietal name suggested for small and weak specimens here described from Madagascar); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 246 (Madagascar; Cape St. André, Madagascar; Madagascar; descriptions of first 2 specimens); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 24 (differs from typical *multiradiata* as *Dichrometra flagellata* var. *afra* differs from typical *flagellata*); Crinoids of the Indian Ocean, 1912, p. 76 (synonymy; localities).

Capillaster multiradiata coccodistoma A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 737, footnote (southeast Africa, Madagascar, and Mauritius).

Capillaster coccodistoma A. H. Clark, Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 245 (*coccodistoma* of Dujardin and Hupé includes this form and *Comanthus wahlbergii*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 10 (in key; range).

Diagnostic features.—This species in general resembles *C. multiradiata*, but is smaller and more slender, with fewer arms and fewer cirrus segments. There are 12–19 arms, and the cirri are XV–XVIII, 21–23.

Characters.—The specimen collected by M. Rousseau in 1841, which, as the only one seen by Carpenter, must be considered as the type of the species, has the cirri XV, 21–23; there are 19 arms; of the 9 IIBr series present, 7 are 4 (3+4) and 2 are 2. Carpenter noted that the mouth is interradial in position. and the lower pinnules have somewhat carinate basal segments.

In the specimen from Cape St. André the cirri are XVIII, 21–22; there are 12 arms, 4 of which are on a single ray which bears 2 IIBr 4 (3+4) series; the brachials are very short with strongly projecting distal ends.

The third specimen resembles the first and possesses 19 arms.

None of the examples has IIIBr series.

Localities.—Cape St. André, Madagascar; about 30 meters; Dr. P. R. Joly, 1901 [A. H. Clark, 1911] (1, P. M.).

Madagascar; M. Rousseau, 1841 [P. H. Carpenter, 1882, 1888; A. H. Clark, 1911] (1, P. M.).

Madagascar [A. H. Clark, 1911] (1, P. M.).

Mauritius; Nicholas Pike [A. H. Clark, 1911].

Erroneous locality.—Southeastern coast of Africa [A. H. Clark, 1911]. The mention of this locality was due to the existence in the Paris Museum of a specimen of *Comanthus wahlbergii* bearing the name *coccodistoma.*

History.—The first mention of this form is an inclusion of the name *Comatula coccodistoma* in 1862 by Dujardin and Hupé as a *nomen nudum* in a list of manuscript names found with specimens of recent comatulids in the Paris Museum.

In 1882 Dr. P. H. Carpenter included *Actinometra coccodistoma* among the comatulids for which he gave specific formulas, and in 1888 he somewhat doubtfully referred to *Actinometra fimbriata,* a specimen he had found under the name of *Comatula coccodistoma* in the Paris Museum which had been brought from Madagascar by M. Rousseau in 1841, and noted certain features exhibited by it.

Prof. Hubert Ludwig in 1899 gave *fimbriata* as questionably occurring in Madagascar on the basis of Carpenter's disposition of the specimen labeled *coccodistoma* in 1888.

In 1910 I visited the Paris Museum and examined there 3 specimens from Madagascar, including the one mentioned by Carpenter.

In an article on the crinoids of Africa published in March, 1911, I recorded these as *Capillaster multiradiata,* remarking that I had compared them directly with a typical specimen of *multiradiata* from the Straits of Sunda (referring to one of the specimens collected by Reynaud in Ceylon in 1829 in the Paris Museum) and that, while they are smaller and proportionately weaker, I could find no other differences whatever; I mentioned that IIIBr series, which are very common in East Indian specimens, do not occur. I added that very possibly these specimens represent a local permanently small race confined to the southeast African region, and that if this should prove to be the case the name *coccodistoma* would be applicable to it.

Later in 1911 in a paper on the recent crinoids in the Paris Museum I again gave brief descriptions of these specimens, this time under the heading *Capillaster multiradiata* var. *coccodistoma.* In this paper the reference to the name *coccodistoma* is given, in a footnote, as "Proc. U. S. National Museum, vol. 39, p. 680." This was taken from the page proof of the article referred to, which was subsequently transferred to volume 40, where the name *coccodistoma* occurs on page 16.

In a monograph of the crinoids of Australia, published in 1911, this form was in the text included in *multiradiata* which was given as occurring at Madagascar and Mauritius; but in a footnote it was stated that the form occurring on the southeastern coast of Africa, and at Madagascar and Mauritius, differs slightly from the typical East Indian variety, and has been differentiated under the subspecific name of *C. m. coccodistoma*.

In my monograph on the crinoids of the Indian Ocean, published in 1912, this form is referred to as *Capillaster multiradiata* var. *coccodistoma* and given as from Madagascar, littoral and down to 30 meters. In the *Siboga* report, 1918, it is inserted as a species, *coccodistoma*, in the key to the species of *Capillaster*.

Genus NEMASTER A. H. Clark

Antedon (part) POURTALÈS, Bull. Mus. Comp. Zoöl., vol. 1, No. 11, 1869, p. 356, and following authors.

Actinometra (part) P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 15, 1880, p. 198, and following authors.

Comaster (part) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Phanogenia (part) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124.

Nemaster A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 503 (genotype *N. grandis*, sp. nov.); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Capillasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 121 (multibrachiate when very small; individuals of species of this genus and of *Capillaster* more solitary than those of other genera of Comasteridae); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represents *Capillaster* in the West Indies); Mem. Australian Mus., vol. 4, 1911, p. 736 (same); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 390 (relation to *Capillaster*, *Neocomatella*, and *Comatella*); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Capillaster*).—SPRINGER and CLARK, Zittel-Eastman's Paleontology, 1913, p. 177 (possesses covering plates only).—A. H. CLARK, Internat. Revue der gesamt. Hydrobiol. u. Hydrol., 1914, pp. 3 *et seq.* (represents *Capillaster* in the Atlantic; range and its significance); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (Caribbean; corresponds to *Capillaster;* connects the Caribbean with the southwestern Indian Ocean); Die Crinoiden der Antarktis, 1915, p. 132 (covering plates); p. 181 (range; Bermudas [error for Bahamas], Caribbean Sea, and southward to Brazil; corresponds to *Capillaster*); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 2 (in key); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies); p. 15 (in key); p. 21 (plantlike interrelationships of the included forms); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, p. 19.—H. L. CLARK, Littoral Echinoderms of the West Indies, 1921, p. 53 (West Indies; littoral).—A. H. CLARK, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range); p. 50 (in key).—GISLÉN, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 15 (multibrachiate condition of the very young [from A. H. Clark]); pp. 35, 36, 38 (brachial homologies); p. 230 (covering plates).

Diagnosis.—A genus of Capillasterinae in which the arms are more than 10 in number, the IIBr series are 4 (3+4) and the IIIBr series are 3(2+3), both being subject to occasional variation and irregularity, the first pinnule of the undivided arms arising from a IIBr or later axillary is on the first brachial, there is a syzygy between brachials 2+3, except on arms arising from a IBr axillary on which the first syzygy is between brachials 3+4, and the brachials beyond the basal are triangular, about as long as broad, becoming elongate wedge-shaped distally.

Geographical range.—From the Bahamas and Dry Tortugas southward, throughout the Caribbean Sea, to Bahia, Brazil.

Bathymetrical range.—From the shore line down to 355 meters.

Thermal range.—From 13.05° C. to 24.83° C.

Remarks.—The genus *Nemaster* represents a more generalized type than *Capillaster*, the relation between the two being approximately the same as that between *Neocomatella* and *Comatella*.

Nemaster is the only genus in the Comasteridae in which most of the species are distinctively colored, the distinctive coloration consisting of lines or spots of dark brown or black. Elsewhere in the Oligophreata such a condition occurs only in the genus *Mariametra* (Mariametridae), and in the Macrophreata it is found only in the genera *Thysanometra* and *Coccometra* (Antedonidae).

The general structure of *Capillaster* and *Nemaster* is quite the same, but the interrelationships of the species included in these two genera are widely different. The two largest species of *Nemaster* (*grandis* and *iowensis*), except for the much longer brachials, resemble in a general way *Capillaster multiradiata*, though both have stouter cirri, which in one are long and in the other short. But the two small species are delicate and slender with black markings—a middorsal line in one (*rubiginosa*) and saddle spots on the pinnule segments in the other (*discoidea*)—and do not in any way resemble the species of *Capillaster*. In *Nemaster* the cirri vary greatly in the several species, but not at all in the same way that they vary in the species of *Capillaster*. They range from slender and delicate to very stout, and consist of from 10 to 35 segments; but in only one species (*grandis*) are there more than 20 cirrus segments.

The arms are always less slender than in the species of *Capillaster*, and they may be (*discoidea*) exceedingly slender and attenuated. In length they vary, in adult individuals, from 80 to 200 mm. The number of arms varies from 11, or possibly 10, to 34, and seems to be exceedingly variable in each species.

The species of this genus are subject to the same extreme irregularity in the division series which is such a remarkable feature of the species of *Capillaster*.

KEY TO THE SPECIES IN THE GENUS NEMASTER

- a^1. No conspicuous dark spot in the middle of each pinnule segment, the pinnules being unicolor or with the tips of a different color from their bases; robust, or at least not markedly slender; cirri XX–XXX, usually over XX; arms 18–43 in number, rarely less than 20.
  - b^1. Stouter; no black median dorsal line on the arms; size usually large, the arms 90–200 mm. in length.
    - c^1. Cirri with 30–35 segments; size large, the arms about 200 mm. long (east coast of Central America; 0–62 meters) ---------- **grandis**, p. 216.
    - c^2. Cirri with not more than 18 segments; small, the arms 90–130 mm. long (Bahamas and Florida to Dominica and Barbados; 1–161 meters) ---------- **iowensis**, p. 218.
  - b^2. More slender; a conspicuous black line, sometimes interrupted, in the middle of the dorsal surface of each arm; size usually smaller, the arms 80–105 mm. in length (Bahamas and Florida to Bahia, Brazil; 0–161 meters) ---------- **rubiginosa**, p. 225.
- a^2. A dark spot in the middle of each pinnule segment so that the pinnules are conspicuously banded with dark red or gray and white or yellow; no median black line on the dorsal surface of the arms; very slender; cirri rarely over XX; arms not more than 20 (Caribbean Sea; shallow water to 355 meters) ---------- **discoidea**, p. 232.

NEMASTER GRANDIS A. H. Clark

Plate 16, Figure 38; Plate 17, Figure 39

Stella marina polyactis, seu *Luna marina* SEBA, Thesaurus, vol. 3, 1758, p. 17, pl. 9, No. 3.
Nemaster grandis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 504 (description; *Albatross* Sta. 2146); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range).

Diagnostic features.—The long cirri, which are about 40 mm. in length and are composed of 30–35 segments, seem to separate this form from *N. iowensis* which it otherwise resembles very closely. The arms are 24–31 in number, about 200 mm. long. It is readily distinguished from *N. rubiginosa* by the absence of the black mediodorsal stripe on the arms, from *N. discoidea* by the absence of the dark spot in the middle of each pinnule segment, and from both by the greater size, more robust build, and much longer and stouter cirri.

Description.—The centrodorsal is thick discoidal with the bare polar area 5 mm. in diameter and deeply concave. The cirrus sockets are marginal and are arranged in 3 closely crowded alternating rows.

The cirri are XXV–XXX, 30–35, about 40 mm. long, large and stout. The first segment is short, about three times as broad as long; those following gradually increase in length to the sixth or eighth which, with the 3 following, is about as long as broad, then gradually decrease so that those from the twelfth or fifteenth onward are about twice as broad as long, though the last 2 are again almost as long as broad. Between the seventh and the twelfth there is a transition segment, proximal to which the segments have a dull finely pitted surface and distal to which they have a highly polished surface, the pits being widely scattered or absent, and dorsal processes. The transition segment is not especially well marked. The segments proximal to it have practically straight sides and no modification of the dorsal distal edge. The transition and following segments have the distal edge dorsally projecting as a transverse ridge which is coarsely dentate, usually tridentate, and equal in length, transversely, to about half the width of the segment. Distally the ridge gradually narrows, becoming bidentate, and on the terminal 4 to 7 segments resolves itself into a single spine which on the antepenultimate becomes subterminal in position. All of the transverse ridges appear as rather prominent spines in lateral view. The opposing spine is prominent, though short, rather stout, and arises from the whole dorsal surface of the penultimate segment. In length it is about equal to one-third the width of that segment. The apex is subterminal or submedian. The distal edge usually makes much less of an angle with the transverse diameter of the segment than the proximal, giving the spine the appearance of leaning forward. The terminal claw is considerably longer than the penultimate segment, stout basally, slender distally, strongly curved proximally, but becoming nearly straight in the distal portion.

The ends of the basal rays are visible as low tubercles in the angles of the calyx, but are with difficulty differentiated from the adjacent parts.

The radials are concealed by the centrodorsal in the median line, but are visible as rather conspicuous triangles in the interradial angles of the calyx. The apex of these triangles separates the lower corners of the IBr_1.

The IBr_1 are oblong, rounded dorsally and laterally, about three times as broad as long, widely separated laterally. The IBr_2 (axillaries) are pentagonal, from one-third to one-half again as broad as long, with the lateral edges, which are about as long as those of the IBr_1, diverging distally. The IIBr series are 4 (3+4). The IIIBr series are 3 (2+3). The division series are separated by a distance about equal to the width of the IIBr series. If all of the IIIBr series are not present, those most frequently absent are the ones on the outer sides of the IBr series, so that there is an approximation to a 1, 2, 2, 1 arrangement.

Arms 24–31, about 200 mm. long. The first brachials are wedge-shaped, rather large, not quite half again as broad as the exterior length, almost entirely united interiorly. The first syzygial pair (formed of brachials 2+3) is not quite so long as broad. The next 4 brachials are oblong, about twice as broad as long, the following becoming wedge-shaped and after 3 or 4 triangular, and about as long as broad. In the terminal portion of the arms the brachials become wedge-shaped and nearly or quite twice as long as broad. The distal edges of the brachials project slightly and are beset with fine spines.

Syzygies occur between brachials 2+3, again from between brachials 14+15 to 22+23 (usually in the vicinity of the eighteenth brachial), and distally at intervals of 3 muscular articulations.

The mouth is marginal and radial. The anal tube is central. The disk is naked, about 30 mm. in diameter. Side plates are developed along the brachial and pinnule ambulacra.

P_D is from 30 to 35 mm. in length, stout, much stouter than the succeeding pinnules, but tapering evenly to a slender and flagellate tip. It consists of 40–45 segments, all of which are about as long as broad. A slight prominence is visible on the dorsal side of the distal edge of the second segment which rapidly becomes larger and increases in width on those succeeding, after about the seventh taking the form of a strong, coarsely spinous eversion of the dorsal edge; this disappears near the proximal part of the distal comb. The comb arises somewhat abruptly. It is composed of 14 teeth, of which the first is low and triangular, the second is oblong or slightly trapezoidal, usually slightly broader basally than high, and those following become more obliquely trapezoidal and relatively somewhat higher, the terminal teeth being truncated triangular. The more proximal teeth are not equal in height to more than three-quarters of the width of the segments that bear them, but the later teeth, owing to the distal tapering of the pinnule, become about equal to the width. P_P is about 25 mm. long, considerably less stout than P_D but otherwise similar to it.

P_1 is about 20 mm. long, much less stout than P_P, though similar to it. P_2 and the following pinnules are slender and delicate, about 10 mm. long. P_2 bears a comb distally, but the following pinnules are without combs. P_2, P_3, and P_4 and the corresponding pinnules on the inner side of the arms have the first 2 segments disproportionately large and produced dorsally into large carinate processes. The distal pinnules are slender, about 12 mm. long, composed of about 25 segments, of which the first is over twice as broad as long, the second is about as long as broad, the third is longer than broad, and the remainder are about half again as long as broad. The distal ends of the segments are slightly everted and finely spinous; the dorsal surface is beset with fine spines, and the last 4 bear long recurved spines dorsally.

Localities.—New Spain (probably the eastern coast of Mexico) [Linck, 1733; Seba, 1758; Brugière, 1792].

Albatross station 2146; off Colon, Canal Zone (lat. 9° 32′ 00″ N., long. 79° 54′ 30″ W.); 62 meters; broken shells; April 2, 1884 [A. H. Clark, 1909] (3, U.S.N.M., 25459). Pl. 16, fig. 38; pl. 17, fig. 39.

Remarks.—One of the more important hitherto unidentified species of comatulids described in the early works on zoology is the *Stella marina polyactis*, seu *Luna Marina*, figured and described by Albertus Seba in 1758, which was said to have come from New Spain.

In the figure, which appears to be very accurate, the 29 arms are 75 mm. long and the cirri are 22 mm. long, with, in the longer, 29–33 segments. Thus the number and length of the arms and the number of segments in the cirri indicate that the figure could represent this species perfectly well.

Seba gave the color as dark purple, and mentioned that it is said that in the night time, when the wind is stilled and when the moon shines, this creature very commonly swims up from the sea bottom to the surface as if yearning for the moonlight.

There is no reason for doubting the correctness of the locality given by Seba, but New Spain is somewhat indefinite. In its widest meaning New Spain included the audiencias or judicial districts of Manila (Philippines), San Domingo, and Guatemala; but in its narrower meaning it comprised the audiencia district of Mexico and the subordinate audiencia district of Guadalajara, which together extended from Chiapas and Guatemala to beyond the eastern boundary of the present State of Texas and northward, eventually, to Vancouver Island.

On the west coast of Central and North America there are none but 10-armed comatulids, all of which live in deep water, so that Seba's specimen could not have come from that region.

The probabilities are that it was taken at Vera Cruz, the port of Ciudad Mexico, though of course there is a chance that it may have been brought from elsewhere. In those days the harbor of Vera Cruz was much cleaner than it is now, so that the absence of comatulids there at the present time is of no significance.

Since this species was first noticed by Seba in 1758 the only specimens which have come to light are the three which were dredged by the *Albatross* in 1884 off Colon.

NEMASTER IOWENSIS (Springer)

Plate 18, Figures 40, 41

[See also vol. 1, pt. 2, fig. 243 (arm), p. 197; figs. 380, 381 (pinnule tip), p. 243; figs. 603, 604 (comb), p. 311]

Actinometra, sp. P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 328.—Nutting, Bull. Lab. Nat. Hist. Univ. Iowa, vol. 3, Nos. 1, 2, 1895, p. 130 ("Perhaps the greatest surprise was when we found [at Dry Tortugas] a magnificent crinoid with a spread of about 12 inches growing in water less than 3 feet deep. These specimens were of a rich golden brown color * * *").

Actinometra iowensis SPRINGER, American Geologist, vol. 30, 1902, p. 98 (preliminary description).—Bull. Lab. Nat. Hist., Univ. Iowa, vol. 5, No. 3, 1903, p. 217 (detailed description; comparisons; side and covering plates); pl. 1, figs. 1–6.—MINCKERT, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, p. 176, footnote; p. 207 (syzygies; regeneration).—HAMANN, Bronns Klassen und Ordnugen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).

Comaster iowensis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 35, 1908, pp. 120, 123 (arm structure); p. 124 (listed); vol. 36, 1909, p. 362 (ambulacral plating).

Nemaster iowensis A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 118 (history of the discovery); Ann. and Mag. Nat. Hist., ser. 8, vol. 5, 1910, p. 361 (side and covering plates).—H. L. CLARK, Bull. Lab. Nat. Hist., Univ. Iowa, vol. 7, No. 5, 1918, p. 7 (history).—A. H. CLARK, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 7 (Bahamas; Tortugas; Dominica; littoral); p. 8 (obtained by the Barbados-Antigua expedition); p. 22 (stations 53, 97, 98, 99, 100; Engineers' Pier, Barbados; Barbados); pp. 27, 28 (listed); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 16 (photograph of a specimen from the Bahamas).—H. L. CLARK, Littoral Echinoderms of the West Indies, 1921, p. 53 (Tortugas; Bermuda [in reality Bahamas]).—A. H. CLARK, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range).

Actinometra echinoptera var. (?)*lineata* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 471 (quotation of Carpenter's remarks).

Actinometra echinoptera var. *discoidea* (part) HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 464, pl. 17, fig. 14 ("apparently" Montserrat, 88 fathoms).

Actinometra blakei (not of P. H. Carpenter, MS.) HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 471 (*Blake* station 171; the specimen described, but not the one referred to); pl. 13, fig. 9.—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584 (listed).

Actinometra echinoptera var. *multicirra* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 472 (*Blake* station 171; description [under the name *blakei*]); pl. 13, fig. 9.

Diagnostic features.—This species resembles *N. grandis* very closely, but the cirri are much shorter, from 10 to 14 mm. in length, with only 12–18 segments; the arms are 23–43 in number, from 90 to 135 mm. long. The color in life varies from sulphur yellow to golden brown or black, uniform or in the dark individuals with yellow tips to the pinnules. In alcohol most of the specimens are uniform dark olive green.

The absence of a dark mediodorsal stripe on the arms distinguishes it from *N. rubiginosa*, and the absence of a dark spot on each pinnule segment distinguishes it from *N. discoidea*. It is also larger and stouter than either of these, with stouter cirri.

Description.—The centrodorsal is thin discoidal, with the dorsal pole broad and very slightly concave, 6 mm. in diameter. The cirrus sockets are arranged in 2 alternating and more or less confluent marginal rows.

The cirri are XXX, 14–18 (in most cases 16), very strongly and evenly recurved and about 25 mm. long. The first segment is very short, the second is almost twice as broad as long, the third is from slightly longer than broad to half again as long as broad, and those following gradually increase in length to the seventh or eighth, which is from half again to almost twice as long as the narrowest width (at the end of about the basal third); from this point onward the segments gradually decrease in length distally, so that the last 3 are usually broader than long, sometimes about as long as broad. The ventral profile of the segments is slightly concave, but the dorsal nearly straight; the ends are somewhat swollen and projecting, especially ventrally. The last 6–8 segments before the penultimate have a slight terminal dorsal tubercle which on the antepenultimate becomes a minute conical terminal dorsal spine. The opposing spine is minute, conical, centrally situated, erect, more slender and sharper than the spine on the preceding segment. The terminal claw is almost or quite half again as long as the very small penultimate segment, slender, and more strongly curved proximally than distally.

The ends of the basal rays are visible in the interradial angles as very small tubercles separating the exceedingly narrow subradial clefts.

The radials are only visible as very narrow triangles, with the inner apices more or less near the mid-radial line. The bases of adjacent triangles—that is, that portion of the lateral edges of the radials that projects beyond the centrodorsal—are separated by a V-shaped gap in which is a conspicuous pore separating the proximal angles of the IBr_1. The IBr_1 are regularly oblong, about four times as broad as long. The IBr_2 (axillaries) are triangular, with the lateral angles truncated and forming short sides which make an obtuse angle with those of the IBr_1; the 2 distal sides, which make with each other approximately a right angle, are slightly concave. The IIBr series are 4 (3+4); in the type the 2 on the left anterior ray are 2 and the other 8 are 4 (3+4). They are narrow and widely separated; the $IIBr_1$ are interiorly in close contact in the proximal half, the distal halves of their inner sides diverging at usually approximately a right angle. The IIIBr series are 3 (2+3); in the type there is 1 IIIBr series composed of a single axillary ossicle and 4 which are 3 (2+3).

The 25 arms of the type are 95 mm. long. The first brachial is about twice as long exteriorly as interiorly, with the inner edge straight and wholly free. The first syzygial pair (composed of brachials 2+3) is approximately oblong, from half again to nearly twice as broad as long. The next 4 brachials are oblong, about three times as broad as long, and those following are triangular, with the distal apex rather abruptly produced, half again as broad as the maximum length. After about the proximal fourth of the arm the brachials gradually become short wedge-shaped, about twice as broad as the maximum length, and the terminal brachials are wedge-shaped and about as long as broad.

Syzygies occur between brachials 2+3, from between brachials 12+13 to between brachials 14+15 (usually between brachials 13+14), and distally at intervals of usually 4 muscular articulations. On one arm following the IIIBr 1 series the first 2 brachials form a syzygial pair. On the 2 adjacent inner arms arising from the IIBr 2 series syzygies occur between brachials 2+3 and 4+5, but on the outer arms the first syzygy is between brachials 2+3, as usual. On an arm arising from a IIIBr 3 (2+3) series syzygies occur between brachials 2+3, 4+5, 6+7, and again between brachials 13+14.

The lower pinnules are unusually slender. P_D is about 22 mm. long, abruptly stouter basally than P_1 and considerably longer; the second segment has a slight carinate ridge. The first 2 segments of P_1 have a conspicuous carinate process which in both is extended distally beyond the end of the segment. P_2 and P_3 are smaller and more slender than P_1; their first 2 segments are somewhat enlarged and bear high and conspicuous carinate crests, which on the first extend distally and on the second both distally and proximally well beyond the end of the segment; the following segments are small and slender. The following pinnules are somewhat stouter and taper evenly from the base to the tip, the first 2 segments not being appreciably different from the others. The pinnules in the middle of the arm are 12 mm. long.

The disk is about 25 mm. in maximum diameter and is without visible calcareous deposits. The mouth is marginal and radial.

A second specimen taken with the type and included with it in the original description has 23 arms, which, according to Mr. Springer, originally measured about 130 mm. in length. All of the IIBr series are 4 (3+4). Of the three IIIBr series present, two are 3 (2+3) and one consists of a single axillary ossicle.

Notes.—As a postscript to his discussion of the comasterids of the *Fimbriata* group, Dr. P. H. Carpenter mentioned a very remarkable specimen which was dredged by the *Blake* in the Caribbean Sea, just where he does not state. He says that at first sight it greatly resembles a large example of *Nemaster lineata*, to which it is very closely allied, but the IIIBr series are represented by single axillary ossicles, and the IVBr series may be of the same character, or they may be 2 (1+2). On the outer arms of each ray the first syzygy is generally between brachials 2+3, and this is sometimes the case also on the inner arms; but the other arms generally have the first syzygy between brachials 1+2.

The specimen from Dominica has the centrodorsal rather large, discoidal, with the dorsal pole flat; there is a single marginal row of cirrus sockets. The cirri are about XV, 14, 10 mm. long, with the earlier segments elongated and the distal short and compressed. The radials are just visible. The IBr series are short and broad, but well separated laterally. The IIBr series are 4 (3+4). The IIIBr series usually consist of a single axillary ossicle, but are rarely 2 (1+2). The 40 arms are about 100 mm. long. In arms arising from a IIIBr 1 series the first syzygy is between brachials 1+2; in arms arising from a IIIBr 2 (1+2) series the first syzygy is between brachials 2+3.

In the specimen from the Engineers' Pier, Bridgetown, Barbados, the centrodorsal is very thin, discoidal, with the flat dorsal pole 5 mm. in diameter, having a slightly depressed circular area 2 mm. in diameter in the center. The cirri, which are arranged in a single very irregular marginal row, are XXII, 13–15, 13 or 14 mm. long. The 43 arms are about 90 mm. long.

In the specimen apparently from *Blake* station 155–156 as described by Hartlaub the centrodorsal is broad, thin discoidal. The cirrus sockets are arranged in 2 rows.

The cirri are XXXVII. The mature cirri are all broken; an immature cirrus has 12 segments. In the stumps of the mature cirri only the basal segment is short, the second being elongated, and the third, fourth, and fifth the longest; from this point the length rapidly decreases, so that the eighth is about as long as broad. The proximal-segments as far as the seventh are constricted centrally, and those following are laterally compressed. The distal segments bear slight dorsal spines. The opposing spine is very small, but in contrast to this the terminal claw is large.

The radials are wholly concealed. The IBr_1 and the pentagonal IBr_2 (axillaries) are very short and not in lateral contact. The IIBr series are 4 (3+4), and the IIIBr series are 3 (2+3), mostly internally developed. The division series have a smooth rounded surface and only very slightly projecting sides.

The arms are nearly 30 in number; one ray is broken off and lost; on the other 4 the arms total 23. The arms, which are all broken, increase very slightly in width from the base.

The first arm syzygy is between brachials 2+3, rarely between brachials 3+4, and the second is usually between brachials 8+9; the distal intersyzygial interval is from 3 to 5, usually 4, muscular articulations.

P_D is about 16 mm. long, flagellate, composed of 37 segments. A few of the basal segments are stout. The first 3 are incorporated in the perisomic plating of the interradial areas of the disk. The pinnule tapers very rapidly in the proximal half. The distal edges of the segments are strongly produced and spiny. The comb is very poorly developed and does not extend on to the terminal segments. While the basal segments are broad, those in the distal half of the pinnule are elongate cylindrical. There is no carination of the basal segments, although the second segment bears a sharpened edge, indicating an incipient carination. On P_P or P_1, however, there is a strong carination of the first, second, and third segments. These pinnules are markedly weaker than P_D, although their length is only slightly less; they are composed of about 33 segments. The comb is very poorly developed and extends over about 6 segments; the terminal segments are not included. The next pinnule is again markedly weaker than those preceding, becoming slender and flagellate beyond the sixth or seventh segment; it is composed of about 20 segments, and there is only a trace of a comb. The difference in size between the basal segments and those following is much less than in P_1, and in the pinnule next beyond this difference is no longer to be seen. This last is shorter, about 5 mm. long, with 10 segments, of which the outer bear a comb of 5 or 6 teeth. From this point the length of the pinnules gradually increases, so that the pinnule on the tenth brachial is 6 mm. long. Except for the few basal segments of the first 2 pinnules, the pinnules are very slender.

The dorsal interradial perisome is plated.

In the specimen from *Blake* station 171, as described by Hartlaub, the centrodorsal is thick, discoidal, with the dorsal pole flat.

The cirri are about XL, about 16, and are arranged in several rows. The first 2 segments are short and the following to the eighth are much elongated, those beyond being shorter with slight dorsal spines. The opposing spine is very small. The cirri are distally strongly compressed laterally.

The radials are not visible. The IBr_1 are very short, markedly narrower than the maximum width of the pentagonal axillary, and laterally free. The IBr_2 (axillaries) are short pentagonal with a somewhat depressed surface, laterally concave, and proximally conspicuously broadened, rising to a synarthrial tubercle on the articulation with the IBr_1.

The arms are 10(?) in number. The first brachials are short discoidal, in contact interiorly. The second are longer, laterally free, and distally broadened. The first syzygial pair (composed of brachials 3+4) is about as long as broad. The following 5 brachials are short discoidal, the next 2 short wedge-shaped, and those succeeding moderately long and triangular. In the distal half of the arms the brachials again become short wedge-shaped.

The first syzygy is between brachials 3+4, and the second is from between brachials 12+13 to between brachials 15+16. The distal intersyzygial interval is usually 4 or 6 (commonly 4) muscular articulations.

P_1 is flagellate, apparently about 15 mm. long, composed of short segments which are not at all or only sparsely and finely spinous. The 5 basal segments are broad and triangular and are only in contact over a small portion of their ends. P_2 is similar, but somewhat shorter. P_3 is markedly shorter. The comb of the proximal pinnules is moderately long and well developed, with about 14 low and widely separated teeth.

Localities.—Bahamas [A. H. Clark, 1921] (1, U.S.N.M., 36164).

Dry Tortugas, Florida; less than 0.9 meter [Nutting, 1895; Springer, 1902, 1903; H. L. Clark, 1918] (2, U.S.N.M., 34496). Pl. 18, figs. 40, 41.

?*Blake* stations 155–156; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [Hartlaub, 1912].

Montserrat, Dominica or Martinique (*Blake* stations 155, 177, or 203) [Hartlaub, 1912] (1 M. C. Z., 429, part; the other specimens are *discoidea*).

Blake station 171; off Guadeloupe (lat. 15° 58′ 20″ N., long. 61° 43′ 12″ W.); 334 meters; temperature 13.05° C.; lava sand and ooze; January 22, 1879 [Hartlaub, 1912].

Dominica; A. H. Verrill [A. H. Clark, 1921] (1, Y. M.).

University of Iowa's Barbados-Antigua expedition station 53; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 97; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 98; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 99; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 100; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition; Engineers' Pier, Barbados; 5.7 meters [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

Blake; Caribbean Sea [P. H. Carpenter, 1888].

Erroneous locality.—Bermudas [A. H. Clark, 1918; H. L. Clark, 1921]. This is an error for Bahamas.

Geographical range.—From the Bahamas and the Dry Tortugas to Barbados.

Bathymetrical range.—Littoral, and down to 334 meters; most of the specimens are from shallow water.

Thermal range.—There are 2 records, 13.05° C. and 20.56° C.

History.—In 1888 Dr. P. H. Carpenter mentioned a very remarkable specimen dredged by the *Blake* in the Caribbean Sea which he placed near *N. rubiginosa* ("*lineata*"). It was chiefly noteworthy for the great irregularity in the division series. On Carpenter's death the specimen disappeared and did not come into Hartlaub's hands with the rest of the *Blake* collection. There can be no doubt that this was an example of the species subsequently described under the name of *iowensis*, and it must have been very similar to the one in the Yale Museum from Dominica.

Prof. Charles C. Nutting wrote (1895) that perhaps the greatest surprise on the Bahaman expedition from the University of Iowa in 1893 was the discovery at the Dry Tortugas of a magnificient crinoid with a spread of about 12 inches and of a rich golden-brown color living in water less than 3 feet deep. The two specimens which he collected served Mr. Frank Springer as cotypes of his *Actinometra iowensis* which he described in 1902, and in more detail, with figures, in 1903.

Mr. Alexander Agassiz told Professor Nutting that he had previously found large comatulids at Tortugas, though apparently he did not preserve any specimens of them, since there are none at the Museum of Comparative Zoölogy, and Hartlaub did not mention any in his memoir on the *Blake* collections.

After the establishment of the Marine Biological Laboratory of the Carnegie Institution of Washington at the Tortugas in 1904 the director, Dr. Alfred Goldsborough Mayor, was constantly on the watch for this species, but never succeeded in finding a single individual. Mr. Frank Springer for many years was very anxious to study the younger stages of some one of the comasterids for comparison with those of *Antedon*, and Professor Nutting's discovery indicated that the Tortugas would be a suitable place for such work. The desire to assist Mr. Springer in carrying out his plans gave Doctor Mayor a special incentive in his quest. But his search, carried on year after year, was fruitless, for no other examples ever were found.

Doctor Mayor was an unusually able and energetic naturalist, and his inability to discover this form—or, indeed, any comatulids of any kind—either along the shore or in deep water annoyed him not a little, for he always referred to it every time we met. He used to say that at the Tortugas laboratory he had two telegrams already written announcing the rediscovery of this type, and Mr. Springer and I must expect to receive them at any time. But a perverse fate never gave him an opportunity to send them.

In his report upon the *Blake* comatulids (1912) Hartlaub described and figured (pl. 17, fig. 14) what is evidently a specimen of this species which he says is apparently from Montserrat in 88 fathoms. He referred it to *Actinometra echinoptera* var. *discoidea*.

Under the heading *Actinometra blakei* he described in detail an individual from *Blake* station 171 which he had originally considered a new form and had provisionally named *Actinometra echinoptera* var. *multicirra*. The specimen is very badly broken, so that the number of the arms can not be determined; Hartlaub gave it as "10(?)." The cirri have about 16 segments, and the photograph shown as figure 9 on plate 13 (to which there is no reference in the text) shows that they are of the type characteristic of *iowensis*.

I have no doubt but that this is a specimen of *iowensis* with a reduced number of arms, for the cirri are obviously of the *iowensis* type and there are no dark marks on the arms or pinnules. As for the small number of arms, this feature is very variable in this group, as I have had occasion to point out in connection with its eastern representatives.

Dr. Hubert Lyman Clark spent the month of June, 1917, at the Tortugas, and at every opportunity searched the reefs and shoals in an effort to find at least one comatulid. Dredging was also carried on continually, but not a trace of any sort of crinoid was ever found.

In 1921 I recorded this species from various stations of the University of Iowa's Barbados-Antigua expedition of 1918, and also from Dominica, from which island there is a specimen in the Yale Museum which was collected by Mr. A. Hyatt Verrill.

On page 2 of the report upon the unstalked crinoids collected by the *Siboga* the range of the genus *Nemaster* as given includes Bermuda, and in his account of the littoral echinoderms of the West Indies published in 1921 Dr. Hubert Lyman Clark, on my authority, gave Bermuda as a locality for this species. I later learned that the specimen upon which this record rested (of which I published a photograph in 1921) had been taken not in the Bermudas but in the Bahamas.

NEMASTER RUBIGINOSA (Pourtalès)

Plate 19, Figures 42–45

[See also vol. 1, pt. 1, fig. 147 (centrodorsal), p. 220; fig. 231 (ventral view of centrodorsal), p. 247; fig. 301 (lateral view of centrodorsal and section of radial pentagon), p. 264; pt. 2, fig. 182 (dorsal view), p. 96; figs. 382, 383 (pinnule tip), p. 243; figs. 607–609 (comb), p. 311; fig. 781 (adambulacral deposits), p. 366; pl. 1, figs. 956, 957 (centrodorsal and radials)]

Antedon rubiginosa Pourtalès, Bull. Mus. Comp. Zoöl., vol. 1, No. 11, 1869, p. 356 (off Orange Key, Bahama Bank, 9 fathoms; off Tortugas, 17 fathoms).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (listed as an *Antedon*).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed).

Antedon, sp. Rathbun, Trans. Connecticut Acad. Sci., vol. 5, 1879, p. 157 (Pernambuco, or Parahyba do Norte; description).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 328, last paragraph.

Actinometra lineata P. H. Carpenter, Journ. Linn. Soc. (Zoöl.), vol. 15, 1880, p. 198 (centrodorsal and radial articular faces); pp. 213, 214 (same); pl. 12, fig. 27, *a*, *b*, (Bahia; centrodorsal and radial articular faces); Proc. Zool. Soc. London, 1882 (1883), p. 747 (specific formula).—von Graff, *Challenger* Reports, Zoology, p. 27, 1884, p. 19 (myzostomes); p. 36 (*Blake* station 285; myzostomes).—P. H. Carpenter, Quart. Journ. Microsc. Sci., vol. 27, 1887, p. 386 (Bahia; no trace of sacculi); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 327 (Bahia, 7–20 fathoms; coast of Brazil; *Blake* station 285 and possibly also 155); pl. 5, figs. 2, *a–e*; pl. 60, fig. 3.—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; after von Graff).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 101 (Brazilian member of the *Fimbriata* group).—Springer, Bull. Lab. Nat. Hist., Univ. of Iowa, vol. 5, 1903, p. 220 (comparison with *Act. iowensis*).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 494 (possesses plated ambulacra).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 281, 413 (=*echinoptera*); p. 419 (a variety of *echinoptera*); p. 421 (*Blake* station 285; myzostomes); p. 422 (*Blake* stations 285 and possibly 155; =*rubiginosa*).

Actinometra rubiginosa P. H. Carpenter, Proc. Zool. Soc. London, 1882 (1883), p. 746 (listed); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 58, 60, 300, 301, 367, 381 (from Pourtalès).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).

Actinometra, sp. P. H. Carpenter, *Challenger* Report, Zoology, vol. 26, pt. 60, 1888, p. 329 (Brazil).

Comaster lineata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 35, 1908, pp. 120, 123 (arm structure); p. 124 (listed); vol. 36, 1909, p. 362 (ambulacral plating present).

Comaster rubiginosa A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia rubiginosa A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Nemaster lineata A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 184 (like *Tropiometra* this species inhabits shallow water in Brazil, deep water in the West Indies); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 12 (probably a West Indian species which has extended its range southward); Crinoids of the Indian Ocean, 1912, p. 23 (littoral, except in the Lesser Antilles; possibly there carried down by sinking of the land); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 6 (references to specimens in the British Museum; Bahia, 7–20 fathoms; notes).

Actinometra echinoptera var. *rubiginosa* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Bibb*, Jan. 21, 1868, Tortugas; off Orange Key, Bahamas, Apr. 1, 1869; *Blake* station 155); p. 418 (Tortugas; Orange Key; Montserrat; 9–17 fathoms); pp. 436–437 (includes *lineata;* detailed account); pl. 17, figs. 4, 18.

Actinometra echinoptera var. *meridionalis-rubiginosa* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Blake* stations 127, 155; Florida); p. 418 (Montserrat, 88 fathoms); p. 438 (detailed account); pl. 17, fig. 5.

Actinometra echinoptera var. *carinata-rubiginosa* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Blake* station 155); p. 418 (Montserrat, 88 fathoms).

Actinometra echinoptera var. *?lineata* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 470, 471 (*Blake* stations 285, 155; discussion).

[*Actinometra*] *linearis* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 437.

Nemaster insolitus (not of A. H. Clark, 1917) H. L. Clark, Bull. Lab. Nat. Hist., Univ. Iowa, vol. 7, No. 5, 1918, p. 6 (University of Iowa's Bahama expedition; no locality).

Nemaster rubiginosa A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, pp. 9–11 (occurrence at Barbados); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range).

Nemaster, sp. A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 7 (Brazil, littoral; Rathbun's record).

Diagnostic features.—While the number of the cirri, cirrus segments, and arms is the same in this species as in *N. iowensis*, the general habitus of the two forms is very different. *Nemaster rubiginosa* is more slender than *N. iowensis* in all its parts and always shows a conspicuous black stripe down the middle of the dorsal surface of each arm, which in some cases may be more or less broken up into a series of dashes or dots. Except for this black line the color appears to be almost uniform, yellow to red or brownish red.

The cirri are XX–XXX, 11–17 (usually not more than 14), 11 mm. long; the arms are 18–34 in number (11 in Pourtalès' young type specimen), from 80 to 105 mm. in length.

The shorter cirri with fewer segments and the dorsal arm stripe separate this species from *N. grandis*, while the presence of the arm stripe, the absence of the dark spots on the pinnule segments, the stouter build, and the shorter brachials, which have more oblique ends, separate it from *N. discoidea*.

Description.—The centrodorsal is discoidal, with the bare polar area rather broad, from 3 to 4 mm. in diameter, and slightly concave. The cirrus sockets are arranged in 2 closely crowded alternating marginal rows.

The cirri are XX–XXX, 11–17 (usually 13–14), 10 mm. long. The first segment is very short, the second is nearly or quite as long as broad, the third is somewhat longer, and the fourth and fifth are the longest, half again as long as broad. The segments following decrease in length so that the terminal 4 are about as long as broad. Beginning with the sixth segment, the distal dorsal edge is somewhat thickened, this becoming, on the last 2 segments before the penultimate, a small subterminal dorsal spine. The opposing spine is submedian or subterminal, slender, erect, short, and sharp; in height it is equal to or rather less than one-third of the diameter of the penultimate segment. The terminal claw is considerably longer than the penultimate segment, stout and strongly curved basally, becoming more slender and less curved distally. The second-fifth or second-sixth segments are centrally constricted with expanded ends, this being especially marked in dorsal view. The segments distal to these have straighter edges and are laterally compressed.

The ends of the basal rays form rather prominent tubercles in the interradial angles of the calyx.

The radials are entirely concealed by the centrodorsal, or are just visible in the interradial angles over the ends of the basal rays. The IBr_1 are very short, oblong, not in contact laterally. The IBr_2 (axillaries) are broadly pentagonal to almost triangular, from two to two and one-half times as broad as long; the lateral edges are not so long as those of the IBr_1 with which they form an obtuse angle. The adjacent IBr_2 are widely separated from each other. The IIBr series are 4 (3+4), rarely 2; the IIIBr series are 3 (2+3), rarely 4 (3+4); the IVBr series are 3 (2+3), but are not often present. The division series are well separated and are rounded dorsally.

The arms are 18–34 in number, from 60 to 80 mm. long. The first brachials are obliquely wedge-shaped, about twice as broad as the median length, interiorly united. The first syzygial pair (composed of brachials 2+3) varies from about as long as broad to about twice as broad as long, being usually about half again as broad as long. The next 2 brachials are oblong, from two to two and one-half times as broad as long, and the following quickly become triangular, not quite so long as broad, and toward the middle of the arm obliquely wedge-shaped, about half again as broad as long, this proportion being maintained almost to the tip, the terminal segments being rather longer and with less oblique ends. The brachials beyond the third have prominent and overlapping distal ends which are armed with fine spines.

Syzygies occur between brachials 2+3, again from between brachials 10+11 to between brachials 13+14, and distally at intervals of from 2 to 6 (usually 4 or 5) muscular articulations.

The disk is naked, or bears a few scattered granules which are usually finely papillose. The lateral interbrachial areas between the division series are usually covered with a calcareous deposit which may or may not be broken up into distinct interradial plates. The mouth and anal tube are about equidistant from the center of the disk; the former is radial or interradial in position.

P_D is from 12 to 14 mm. long, rather stout basally, but rapidly tapering and slender in the distal half, and is composed of 40 segments, of which the first 5 are broader than long and the remainder are about as long as broad. The terminal comb consists of 12 teeth which are triangular, small, slender, and well separated basally, and not quite so high as the width of the segments that bear them; on the inner side of each of the pinnule segments involved in the comb there is a similar, but smaller, tooth. P_P is from 11 to 13 mm. long, similar to P_D. P_1 is similar to

P_P, but slightly shorter and more slender. P_2 and the following pinnules are 7 mm. long, slightly stouter than P_1, composed of 20 segments, all but the first 2 or 3 of which are about as long as broad. They are without terminal combs, and carry gonads on the first-ninth segments. Distally the pinnules become gradually longer and more slender, reaching a length of 9 mm. In the distal pinnules the first 2 segments are short, the third and fourth are about as long as broad, and those following become progressively elongated and rather over twice as long as broad distally. The segments of all but the oral pinnules have projecting and spinous distal edges.

The color in alcohol is reddish or yellowish brown, with a dark purple mediodorsal line on the arms. The specimens examined are dull yellowish white with a deep brown mediodorsal line on each arm.

Notes.—Count Pourtalès in his original description gave the number of arms as 10 and the mouth as central. He noted that the centrodorsal is slightly convex, with the cirri arranged in 1 or 2 rows about the circumference. The cirri are XV–XX, 10, with the segments nearly cylindrical, the third-fifth the longest, and the penultimate with an opposing spine. The radials and the IBr_1 are visible, the latter being about twice as broad as long. The IBr_2 (axillaries) are pentagonal, depressed in the center into a shallow pit marked with a black spot. There is a similar pit on several of the brachials, which are long, with imbricated and serrated ends. P_1 is much longer than the succeeding pinnules. All of the pinnules are very slender with fine spines on every segment, forming also a verticil at their distal ends. The spines are directed forward near the beginning of the pinnules, but gradually curve back, and the last segment terminates in several hooked claws. The color is rusty red with a black dorsal stripe on every arm and black ambulacral furrows.

Hartlaub reexamined the type specimen and noted that it had 11 arms, there being present a IIBr 4 (3+4) series, and also that the basal segments are strongly carinate. He described the IBr series as entirely free laterally. The radials and the first brachials are not at all, or only very slightly, in contact. The brachials, except for the proximal, are very long and wedge-shaped. On the articulation between two brachials the dark dorsal line of the arm is broadened.

I have also examined Pourtalès' type specimen. There are 2 cirri remaining, each with 10 segments. They resemble the cirri of small individuals of species of *Nemaster*. There are 11 arms, the single IIBr series being 4 (3+4). The first arm syzygy is between brachials 2+3. The first and second segments of P_D, P_1, and P_2 have prominent high carinate processes resembling those on the basal segments of the proximal pinnules in *Leptonemaster;* smaller, but similar, processes often occur on the basal segments of the pinnules next following. There is a conspicuous and rather broad median line of dark brown on the arms beyond the second brachial.

In the specimen from the University of Iowa's Bahamas expedition as described by Dr. Hubert Lyman Clark the centrodorsal is flat and discoidal, 4 mm. across. There seem to have been XXI cirri, but only 9 remain. The arms are 18 in number, 8 being broken off. The centrodorsal and the cirri are white, while the arms are light brown, with the center of the serrate distal margin of each brachial darker brown; the pinnules are lighter.

The arm fragments from *Bibb* station 80P undoubtedly belong to this species.

In the specimen collected by Dr. Th. Mortensen at Thatch Island there are 20 arms 105 mm. long; all the IIBr series are present, and all are 4 (3+4). The centrodorsal is 3 mm. across the flat dorsal pole. The cirri are XXX, 11–12, 11 mm. long. The division series are narrow and well separated.

Under the name of *meridionalis-rubiginosa* Hartlaub recorded 3 small 10-armed specimens which very clearly show the dark arm stripe of *rubiginosa*. The first is from *Blake* station 155, the second is from Florida, and was determined apparently by P. H. Carpenter as *rubiginosa*, and the third is from *Blake* station 127. All 3 have moderately broad division series, and the IBr_1 are in lateral contact. Hartlaub says that the specimen from *Blake* station 155 has the centrodorsal and cirri of *meridionalis* [*echinoptera*], and in the proximal half of the arms short, not triangular, brachials with everted ends; there are no spines on the pinnules. The specimen from *Blake* station 127 has a few somewhat elongated cirrus segments; it does not have the more or less triangular basal pinnule segments in the proximal portion of the arms which are so characteristic of *meridionalis* [*echinoptera*], so that, more than the other 2, it approaches *rubiginosa*. But, on the other hand, it differs from *rubiginosa* in the absence of spines on the pinnules. The specimen from Florida, in contrast to the other 2, has spiny pinnules, and also in other ways is the most like *rubiginosa* of the 3. The cirri unfortunately have been lost.

Three specimens from *Blake* station 155, determined by Hartlaub as *meridionalis-rubiginosa*, are very similar to the example from Florida just mentioned and, like it, have spiny pinnules. They are accompanied by the name *rubiginosa*, the determination apparently having been made by Carpenter. Two of them show a dark arm stripe. In their cirri, broad IBr series, flat centrodorsal, and rather short brachials they show, according to Hartlaub, characters of *meridionalis* [*echinoptera*.]

The specimen from *Blake* station 285 has 18 arms.

In the specimens from Brazil recorded by Rathbun the cirri were XII–XVI, 11–12. The arms numbered from 11 to "at least 20," and were 45 mm. long.

Carpenter remarked that this Atlantic species may readily be distinguished by the greater relative length and more quadrate shape of the brachials, the edges of which are by no means so spiny as in *Capillaster multiradiata* and its allies. The relative shortness of the intersyzygial interval and the frequent plating of the interradial perisome he considered as distinctive characters of minor value.

He noted that in this species the position of the mouth seems to be somewhat variable. So far as he was able to make out, it is radial in the Caribbean specimens, but interradial in the Brazilian.

Neither of the Caribbean specimens which he was able to examine had any IIIBr series, and these were sometimes absent in those from Brazil.

Abnormal specimen.—The example from Bahia figured by Carpenter (pl. 60, fig. 3) has 8 of the IIBr series 4 (3+4) and 2 of two ossicles only, though this is not mentioned by Carpenter in the text.

Localities.—*Bibb* station 162P (Nos. 2 and 3); off Orange Key, Bahamas; 16 meters; April 1, 1869 [Pourtalès, 1869; Hartlaub, 1912] (1, M. C. Z., 496).

University of Iowa's Bahamas expedition; no locality [H. L. Clark, 1917].

Bibb station 80P (2A); south of the Dry Tortugas (lat. 24° 27′ 30″ N., long. 82° 59′ 30″ W.); 31 meters; mud; January 15, 1869 [Pourtalès, 1869; Hartlaub, 1912] (fragments, M. C. Z., 497).

Florida [Hartlaub, 1912].

Blake station 127; off Santa Cruz, Virgin Islands (lat. 17° 46′ 10″ N., long. 64° 53′ 15″ W.); 69 meters; temperature 24.83° C.; sand, black specks, and shells; January 4, 1879 [Hartlaub, 1912].

Off the western end of Thatch Island, Virgin Islands; 25–29 meters; Th. Mortensen, March 12, 1906 (1, C. M.). Pl. 19, fig. 45.

Blake station 155; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [P. H. Carpenter, 1888; Hartlaub, 1912].

Blake station 285; off Barbados (lat. 13° 05′ 12″ N., long. 59° 37′ 18″ W.); 24 meters; coral bottom; March 7, 1879 [von Graff, 1884; P. H. Carpenter, 1888; Hartlaub, 1912; A. H. Clark, 1921] (1, M. C. Z., 197).

Pernambuco or Parahyba do Norte, Brazil; Dr. John C. Branner [Rathbun, 1879; P. H. Carpenter, 1888; A. H. Clark, 1921] (3,U.S.N.M., 34833).

Challenger; Bahia, Brazil; 13–37 meters [P. H. Carpenter, 1880, 1887, 1888; A. H. Clark, 1913] (6, U.S.N.M., 17528; M. C. Z., 196; B. M.). Pl. 19, figs. 42–44.

Geographical range.—From the Bahamas and the Dry Tortugas southward to Bahia, Brazil.

Bathymetrical range.—From 16 to 161 meters.

Thermal range.—There are 2 records, 20.56° and 24.83° C.

History.—This species was originally described by Count Pourtalès from an immature specimen from off Orange Key, Bahama Bank, in 9 fathoms, and some detached arms from a large individual dredged near the Tortugas in 17 fathoms. Pourtalès gave the number of arms as 10, and said that the mouth is central. He described it under the generic name *Antedon.*

In his memoir on the genus *Actinometra* published in 1879 Dr. P. H. Carpenter, on the basis of Pourtalès' description, determined *Antedon rubiginosa* as a true *Antedon.*

In 1879 Dr. Richard Rathbun, in a paper on Brazilian echinoderms, under the heading of "*Antedon,* sp." gave a minute description of some specimens which had been found in great abundance at some locality not definitely recorded, but either on the coast of Pernambuco or of Parahyba do Norte, by Dr. John C. Branner.

In 1880 Dr. P. H. Carpenter in a discussion of fossil comatulids described and figured in detail the centrodorsal and radials of this species, the material having been collected by the *Challenger* at Bahia. He referred to it under the name of *Actinometra lineata.*

Prof. F. Jeffrey Bell in 1882 listed *Antedon rubiginosa,* following Carpenter (1879) in the generic allocation of the type; but Carpenter had now received from Mr. Alexander Agassiz the *Blake* and other collections brought together by the ships of the United States Coast Survey, and in his critical commentary on Bell's paper dated 1882, but published early in 1883, he was able to place *rubiginosa* correctly in the genus *Actinometra.*

Prof. Ludwig von Graff in 1883 described the myzostomes from a specimen from *Blake* station 285. These had been sent him by Carpenter, who had identified the host as *Actinometra lineata*.

In 1887 Carpenter mentioned the fact that in *Actinometra lineata* from Bahia there are no traces of sacculi.

In 1888 Carpenter described *Actinometra lineata* in detail, republishing the figures of the centrodorsal and radials which he had given in 1880 and adding new ones. The description was based on 8 specimens collected by the *Challenger* at Bahia. He gave as additional localities for the species *Blake* station 285, "and possibly" *Blake* station 155, and expressed his belief that the "*Antedon*, sp." described by Rathbun from Brazil is identical with *lineata*. In addition to the technical description and systematic discussion, Carpenter in the introductory portion of his report gave many notes on the centrodorsal and radials and associated structures, the characteristic features of the arm division, and the position of the mouth.

In the *Challenger* report Carpenter included *rubiginosa* among the 10-armed species of *Actinometra*, and remarked that it had been described by Pourtalès as an *Antedon* before *Antedon* and *Actinometra* had been distinctly separated. He assigned it to the *Echinoptera* group, characterized by having the elements of the IBr series united by synarthry, and 10 arms only. Within this group he placed *echinoptera*, *meridionalis*, *pulchella*, *rubiginosa*, and *blakei* (MS.). He mentioned that IIBr 4 (3+4) series "occasionally occur in *Actinometra rubiginosa*," so that evidently he had discovered that Pourtalès' type has 11 arms instead of 10 as stated in the original description, as in the habitat he gave for *rubiginosa* he mentioned only the localities given by Pourtalès.

Carpenter said in the *Challenger* report that he did not know for certain of any Atlantic representative of the *Parvicirra* group, though there is possibly one on the Brazilian coast. He referred to the small specimens of *Nemaster rubiginosa* described by Rathbun.

In 1900 Dr. Hubert Lyman Clark, misled by Pourtalès' description and Carpenter's disposition of the type in the *Challenger* report, recorded *Comactinia echinoptera* under the name of *Actinometra rubiginosa* from Porto Rico.

On Carpenter's death the *Blake* collection of comatulids was turned over to Dr. Clemens Hartlaub, whose memoir upon them was published in 1912.

Hartlaub considered all of the American comasterids excepting *Actinometra* [*Comatonia*] *cristata*, the habitat of which was unknown to him, as representing varieties of *Actinometra* [*Comactinia*] *echinoptera*. He found that Pourtalès' specimen from the Bahamas, instead of having 10 arms as described by Pourtalès, in reality has 11, one IIBr 4 (3+4) series being present, while the arm fragments from the Tortugas are quite like the arms of Carpenter's *lineata*.

He considered that *rubiginosa* represented a variety of *echinoptera* very close to var. *carinata* (*Leptonemaster venustus*), and also to var. *meridionalis* (a shallow water form of *Comactinia echinoptera*), but in the other direction he considered it allied with var. *discoidea* (*Nemaster discoidea*) through the possession of a IIBr 4 (3+4) series.

He remarked that if Carpenter's description of *lineata* be compared with the characters of the type specimen of *rubiginosa* and with the arm fragments noted by

Pourtalès from the Tortugas there remains scarcely a doubt that Carpenter's species is also a variety of *echinoptera* very close to var. *rubiginosa*.

Hartlaub recorded and described a number of specimens under the names *Actinometra echinoptera* var. *rubiginosa*, *Actinometra echinoptera* var. *meridionalis-rubiginosa*, *Actinometra echinoptera* var. *carinata-rubiginosa*, and *Actinometra echinoptera* var. *?lineata*.

In 1918 Dr. L. H. Clark recorded under the name of *Nemaster insolitus* a specimen of this species from an unknown locality which came to him with the material from the University of Iowa's Bahamas expedition of 1893. The coloration which he gives—the light pinnules and the dark brown spot on each brachial—shows that what he had was an example of this form and not of *insolitus* (*discoidea*).

After the return of the *Blake* collection to the Museum of Comparative Zoölogy at Cambridge I examined Pourtalès' original specimens and confirmed Hartlaub's suggestions regarding the identity of Pourtalès' *rubiginosa* and Carpenter's *lineata*, and also noted that Pourtalès' type from Orange Key had 11 arms and not 10 as described by him. In my report upon the crinoids of the University of Iowa's Barbados-Antigua expedition of 1918 which was published in 1921 I therefore substituted the name *rubiginosa* for *lineata* in the records of the crinoids already known from Barbados.

NEMASTER DISCOIDEA (P. H. Carpenter)

Plate 19, Figures 46, 47; Plate 20, Figure 48

[See also vol. 1, part 1, fig. 232 (ventral view of centrodorsal), p. 247; fig. 324 (cirrus), p. 279; fig. 451 (dorsal view of radial pentagon), p. 353; part 2, figs. 9, 10 (centrodorsal and radials). p. 6; figs. 384, 385 (pinnule tip), p. 243; figs. 605, 606 (comb), p. 311]

Actinometra discoidea (*nomen nudum*) von Graff, *Challenger* Reports, Zoology, pt. 27, 1884, p. 19 (myzostomes); p. 37 (*Blake* stations 155, 203; myzostomes).—P. H. Carpenter, *Challenger* Reports, vol. 26, Zoology, pt. 60, 1888, pp. 58, 316, 317, 368, 382.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 101 (Caribbean representative of the *Fimbriata* group).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 281, 413 (=*echinoptera*); p. 421 (*Blake* station 155; myzostomes).

Actinometer discoidea Springer, Bull. Lab. Nat. Hist. Univ. Iowa, vol. 5, 1903, p. 220 (comparison with *Act. iowensis*).

Comaster discoidea A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 35, 1908, pp. 120, 123 (arm structure); p. 124 (listed).

Actinometra echinoptera var. *discoidea* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 417 (*Blake* station 231); p. 419 (discussion); pp. 463–469 (detailed description and discussion; Montserrat, 88 fathoms; Martinique, 96 fathoms; Dominica, 118 fathoms; St. Vincent; Barbados, 1873, Capt. Werner [Kiel Mus.]); pl. 17, figs. 7, 9, 15.

Actinometra echinoptera var. *rubiginosa-discoidea* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 417 (*Blake* station 231); p. 418 (St. Vincent, 95 fathoms); pl. 17, fig. 9.

Nemaster insolitus A. H. Clark, Proc. Biol. Soc. Washington, vol. 30, 1917, p. 65 (detailed description; *Albatross* station 2146); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 23 (=*N. discoidea*).

Nemaster discoidea A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 8 (obtained by the Barbados-Antigua expedition); p. 11 (occurrence at Barbados); p. 23 (stations 50, 51, 70, 79, 85, 92, 101; Barbados); pp. 27, 28 (listed); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 38 (range).

Diagnostic features.—This is a slender and delicate species, and is at once distinguishable from all the others in the genus by the striking coloration of the pinnules which have a large black, blackish, or at least very dark, spot in the middle of each segment, so that the much lighter white, yellow, or reddish ends stand out prominently and the pinnules as a whole appear like strings of minute alternately dark and light beads.

The cirri are XV–XXI, 10–12, from 10 to 12 mm. long, and slender; the arms are 11–20, from 75 to 150 mm. long, delicate, with rather long brachials which have the ends less oblique than usual.

Description.—The centrodorsal is discoidal, broad, rather thin, the broad flat polar area from 3 to 4 mm. in diameter, sometimes with a slight shallow median pit. The cirrus sockets are closely crowded, arranged in one and a more or less complete second alternating marginal rows.

The cirri are XV–XXI, 10–12, from 10 to 12 mm. long. The first segment is very short, the second is about as long as broad or slightly longer than broad, the third is from half again to nearly twice as long as its proximal width, and the fourth is the longest, twice as long as its proximal width or even somewhat longer. The fifth is as long as the third, and the following gradually decrease in length to the antepenultimate, which is about as long as broad. The penultimate segment is somewhat longer ventrally than dorsally, from one-third to one-half again as broad as its ventral length. The opposing spine is small, erect, arising from the whole dorsal surface of the penultimate segment, with its apex slightly beyond the center of the latter. The terminal claw is long and slender, about three-quarters as long as the penultimate and antepenultimate segments together, moderately curved. As viewed dorsally the second and following segments as far as the terminal 3 or 4 are very strongly constricted centrally, with much expanded ends; but this feature is only slightly marked in lateral view, being due to the lateral expansion of the articulations over the ends of the articular ridges as a center.

Most of the segments are smooth dorsally, but the antepenultimate always, the preceding one often, and the one preceding that sometimes has a small subterminal tubercle or small spine which, though often but slightly marked, is always present. Its position on the antepenultimate segment is but little in advance of the center, on the preceding more distal, and on the third from the last it is situated near the distal edge.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal in the radial line, but show slightly in the interradial angles. The IBr_1 are oblong, with the proximal border often convex, about two and one-half times as broad as the median length, rounded laterally and entirely separated, even at the base. The IBr_2 (axillaries) are almost triangular, between one and one-half times and twice as broad as long, the distal angle sharp, though not produced, the lateral sides short, and forming an obtuse angle with those of the IBr_1, or parallel in the proximal half but diverging in the distal. The IIBr series are 4 (3+4). The division series are comparatively narrow and widely separated. The first ossicles following each axillary are united interiorly for about the proximal two-thirds, those following the IBr axillary then diverging at an acute angle, those following the IIBr axillary remaining in apposition, though not united.

Arms 16–20, about 150 mm. long, very slender. The first brachials are wedge-shaped, about twice as broad as the exterior length. The second are similar in shape and size. On arms arising from a IIBr axillary the first brachials are much larger, being not greatly broader than the exterior length. The first syzygial pair (on arms arising from the IIBr axillaries composed of brachials 2+3, and on those arising from the IBr axillaries composed of brachials 3+4) is oblong, about half again as broad as long, or slightly longer. The following 3 brachials (the following 1 or 2 on arms arising from a IIBr axillary) are oblong, about twice as broad as long, those succeeding becoming very obliquely wedge-shaped, about as long as broad, in the distal part of the arm less obliquely wedge-shaped, almost oblong, about as long as broad, and in the attenuated terminal portion longer than broad. After the first 2 or 3 the brachials develop overlapping and finely spinous distal edges which become prominent after the sixth or eighth, though their development is never very great; they are plainly evident even in the attenuated terminal portion of the arm.

Syzygies occur between brachials 3+4 (brachials 2+3 in arms arising from a IIBr axillary), again between brachials 6+7 to 9+10, and distally at intervals of 4 muscular articulations.

The mouth and anal tube are about equidistant from the center of the disk. The mouth is radial. The disk is entirely covered with a pavement of very small plates, with a few larger ones which rise above the general surface scattered about the interambulacral areas. In the lateral interbrachial regions of the disk the mass of small plates tends to divide into two columns of large plates based upon a single plate in the interradial angle.

P_D is 12 mm. long, stout basally but tapering rather rapidly and slender and flagellate in the distal two-thirds. It is composed of nearly 40 segments, of which the first is about twice as broad as long, the second is nearly as long as broad, the third is of about the same proportions, and the following gradually increase in length, becoming about as long as broad after the seventh and slightly longer than broad in the terminal portion. The segments in the proximal third have very prominently everted and spinous distal ends. The comb consists of 13 teeth, the terminal 2 or 3 more or less obsolete. The teeth are slightly longer than broad basally, about as long as the width of the segment which bears them, rounded, well separated, and beset with small marginal spines. Except for the first 2 or 3, all the teeth are double, the segments bearing another similar, but smaller, tooth on the opposite side. P_1 is 7 mm. long, much more slender than P_D though similar to it, and with a similar comb. P_3 is small, slender, and weak, 3 mm. long with about 15 segments, and bears a more or less imperfect comb distally. P_4 and the following pinnules resemble P_3, but are without combs. On arms arising directly from a IBr axillary, P_1 resembles P_D as described, P_2 resembles P_1, etc. The distal pinnules are 9 mm. long, very slender, with about 20 segments, of which the first is short, the second is half again as long as broad, and those following become rapidly elongated and about three times as long as broad. The segments all have very strongly overlapping and spinous distal ends, as do the segments of all the pinnules except in the distal portion of the first 1 or 2.

The color in alcohol is white, yellowish white, or violet, the cirri and pinnules dark purple with the ends of the segments white, in sharp contrast.

Notes.—The specimen from Antigua has 19 arms.

Hartlaub described this species, under the name of *Actinometra echinoptera* var. *discoidea*, on the basis of 5 specimens which he found in a single jar labeled in Carpenter's hand "*Actinometra discoidea.*" There were 3 locality labels in the jar, Montserrat, 88 fathoms [*Blake* station 155], Martinique, 96 fathoms [*Blake* station 203], and Dominica, 118 fathoms [*Blake* station 177]. In addition to these he had 2 very young specimens, one from St. Vincent [*Blake* station 231] and the other from Montserrat, 88 fathoms [*Blake* station 155].

His largest specimen, which he described in very considerable detail, represents not this species but *N. iowensis.*

Hartlaub says that the most striking features of *discoidea* are a plating of the dorsal interradial perisome and a dark brown spotting of the pinnule segments, the distal ends of which are everted and finely spinous.

Four of the specimens studied by him lacked the interradial plating of the disk and possessed strong carinate processes on the basal segments of the proximal pinnules resembling those seen in *Leptonemaster venustus.* He noted that the interradial plating is also found in *rubiginosa* ("*lineata*"), though not constantly, and in this species also the basal segments of the lower pinnules are sometimes slightly carinate.

The centrodorsal is medium sized, always flat, discoidal, sometimes bluntly pentagonal, always with the cirrus sockets in a single marginal row.

The segments in a well-developed cirrus from a small specimen from *Blake* station 155 number 19. In general the cirri resemble those of *Leptonemaster venustus* except for the somewhat elongate 2 basal segments.

The radials are visible. The IBr_1 and IBr_2 are somewhat longer than in *N. iowensis.* The IBr series are not in lateral contact, but the perisome between them is plated. The IIBr series are 4 (3+4). All the division series have the dorsal surface smooth and strongly rounded. The component segments have only very slightly produced ends. Synarthrial tubercles are sometimes feebly developed. There are no IIIBr series.

Hartlaub figured a very young specimen with 11 arms from *Blake* station 231 in which the interradial perisomic plating is very well developed.

The largest specimen examined by Hartlaub had 14 arms, four of the postradial series having 3 arms each and the fifth 2.

The next smaller, which had at least 17 arms, had 3 postradial series with 4 arms each.

A younger example had 2 postradial series with 4 arms, two with 3 arms, and one with only 2 arms, making 16 arms in all.

A still younger specimen had all of the postradial series with 2 arms.

The arms are rather slender at the base, and taper sometimes rather rapidly and sometimes very gradually.

The brachials up to the sixth are quadrangular, those following becoming rather markedly wedge-shaped, although not triangular. After the tenth the brachials slowly become elongate wedge-shaped, and later acquire a more rectangular form, which is constant after about the fortieth. The elongation of the brachials is apparent beyond the thirtieth. As far as the sixth the brachials are almost cylindrical, but beyond that point they are always somewhat compressed laterally. Their distal ends are produced.

The first syzygy on arms arising from a IBr axillary is between brachials 3+4, the second is usually between brachials 11+12, and those succeeding are separated by intervals of 3 or 4 muscular articulations. In arms arising from a IIBr axillary the first syzygy is between brachials 2+3, the next is usually between brachials 8+9, and the distal intersyzygial interval is from 3 to 5 (usually 4) muscular articulations. The syzygial pairs are much elongated.

In the largest specimen there is an unusually great difference in size between P_1 and the pinnules following. It possesses the enlarged basal segments, which is not the case with P_2 or P_a. In this specimen P_1 is about 13 mm. long, with a comb consisting of about 12 teeth. The pinnules following have no comb. In the distal half of the arms the pinnules are slender and filiform, about 6 mm. in length and composed of about 15 elongated segments.

In a very slender young specimen, apparently from *Blake* station 155, P_1 is the only pinnule with enlarged basal segments, and none of the pinnules have carinate basal segments.

In a younger specimen from *Blake* station 231 there are no traces of keels on the basal pinnule segments, and the size relationships of the lower pinnules are as in the preceding.

In the youngest specimen, from *Blake* station 155, there is no carination of the basal pinnule segments, but instead there are only spinous eversions of the distal ends of the segments.

The disk is beset with calcareous concretions. The mouth is interradial.

The color, as preserved, is white, whitish, or brownish. The centrodorsal and cirri are always white. The most striking feature of the coloration is the brown upper surface of the pinnule segments which alternates with the white produced and everted distal ends, so that the pinnules in dorsal view appear ringed with brown and white.

Of the 4 specimens from Montserrat, Dominica, and Martinique in the Museum of Comparative Zoölogy, which are undoubtedly the ones described by Hartlaub, one has 15 arms, one is smaller, with 18 arms, and the remaining 2 are very small.

Two specimens in the Kiel Museum collected at Barbados by Captain Werner in 1873 as described by Hartlaub have the centrodorsal large, flat discoidal, with the cirri strictly marginal.

The cirri are short, about XX, about 14. The first segment is short, the second is already elongated, and the third-fifth are much elongated. The following segments decrease gradually in length, and the distal bear dorsal spines. The terminal claw is very strong. The proximal portion of the cirri is cylindrical, the distal laterally compressed.

The radials are only partially visible in the angles of the calyx. The IBr_1 are entirely visible, rather broad, free laterally, and of considerable length. The IBr_2

(axillaries) are short pentagonal, with the distal angle somewhat produced. The IIBr series are 4 (3+4), rather long; the $IIBr_1$ are partially in contact. There are no IIIBr series.

The arms are 16–20 in number, exceedingly slender, appearing very rough because of the concave surface and somewhat produced distal ends of the brachials. The arms taper uniformly and gradually from the base. The first 4 or 5 brachials are discoidal, approximately as long as broad. These are followed by some triangular brachials of moderate length, which after the twelfth to the fourteenth become bluntly wedge-shaped. The length of the brachials remains moderate until near the ends of the arms, they not being strongly elongated. The outer brachials are slightly wedge-shaped. In arms arising from a IBr axillary the first 2 brachials are much enlarged and similar to the first 2 elements of a IIBr series.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4, the second is between brachials 6+7, and those following occur at intervals of 4 muscular articulations. In arms arising from a IIBr axillary the first syzygy is between brachials 2+3, the second is between brachials 5+6 to 8+9, and those following are separated by usually 4, more rarely 3, muscular articulations. The syzygial pairs are elongated, beyond the middle of the arm being approximately twice as long as a single brachial.

In the larger 20-armed specimen P_D is about 12 mm. long and is composed of 40–50 segments, of which the 3–5 basal are large and strongly broadened and those succeeding much more slender, so that beyond these enlarged basal segments the pinnule appears flagellate. The 2 or 3 lowest segments are slightly carinate. The terminal comb is poorly developed.

In the smaller 16-armed specimen P_D does not show the strong contrast between the basal and the later segments, and the pinnule tapers gradually outward from the base. One or two of the basal segments are carinate.

P_1 is of the same character as P_D, but in the smaller specimen it is much weaker. The carination of the basal segments is more strongly marked than it is in P_D.

P_2 is very short and is composed of only 10–14 segments, of which the basal are carinate. The terminal comb is either very short or altogether lacking.

P_3 is somewhat longer than P_2 and is without any carination of the basal segments; it sometimes shows a trace of a comb.

The distal pinnules are about 6 mm. long with elongated and centrally constricted segments which have produced and spinous distal ends. Only the basal segments are short, and these are not remarkable for any special enlargement.

The disk of the larger specimen is 9 mm. in diameter. In both examples the mouth is strongly excentric, and in both the disk is thickly beset with small conical papillae and calcareous concretions. Between the division series of the smaller specimen there is a pavement of rhombic calcareous plates. In the larger this calcareous covering of the interradial perisome forms a continuous plating, which appears to be composed of small irregularly formed calcareous plates, and the surface is beset with conical prominences.

In color the larger specimen is light brownish white with a longitudinal darker median stripe on the arms. The centrodorsal and the cirri are white. The smaller specimen is pure white with a small reddish dot resembling a sacculus in size and color on each pinnule segment, excepting for those of the 2 or 3 proximal pinnules.

In the larger specimen the pure white ends of the pinnule segments contrast with the darker central portion. In the smaller the larger segments are pure white, but each has a small sharply outlined reddish brown dot.

In a magnificient specimen from the University of Iowa's Barbados-Antigua expedition station 51 the centrodorsal is thin discoidal with the flat dorsal pole 5 mm. in diameter and showing a shallow central depression. The cirri are XXIV, 13, from 12 to 14 mm. long. The 20 slender arms are about 150 mm. long. All of the IIBr series are 4 (3+4).

A small specimen collected by the same expedition at Barbados has 15 arms 45 mm. long.

In the list of varieties of *Actinometra echinoptera* with their localities Hartlaub gave *Actinometra echinoptera* var. *rubiginosa-discoidea* from *Blake* station 231. He does not mention this combination in the text, and it is not quite clear to which specimen he refers. It seems to be, however, the 11-armed example now in the Museum of Comparative Zoölogy which he figured on Plate 17, Figure 9.

Localities.—*Albatross* station 2161; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 20′ 28″ W.); 267 meters; coral bottom; April 30, 1884 (fragments, U.S.N.M., 34500).

Albatross station 2168; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 20′ 20″ W.); 233 meters; coral bottom; May 1, 1884 (1, U.S.N.M., 34532).

Albatross station 2330; off Habana, Cuba (lat. 23° 10′ 48″ N., long. 82° 19′ 15″ W.); 221 meters; fine gray coral; January 17, 1885 (3, U.S.N.M., 34535).

Albatross station 2323; off Habana, Cuba (lat. 23° 10′ 51″ N., long. 82° 19′ 03″ W.); 298 meters; white broken coral; January 17, 1885 (1, U.S.N.M., 34533).

Albatross station 2326; off Habana, Cuba (lat. 23° 11′ 45″ N., long. 82° 18′ 54″ W.); 355 meters; broken coral; January 17, 1885 (2, U.S.N.M., 34534). Pl. 19, figs. 46, 47.

?Off Habana, Cuba; *Albatross*, 1885 (1, U.S.N.M., 34536).

University of Iowa's Barbados-Antigua expedition station 101; Antigua [A. H. Clark, 1921] (1, U. I. M.).

Blake station 155; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [von Graff, 1884; Hartlaub, 1912].

Blake station 177; off Dominica (lat. 15° 32′ 18″ N., long. 61° 30′ 10″ W.); 216 meters; temperature 18.33° C.; sand and broken shells; January 24, 1879 [Hartlaub, 1912].

Blake station 203; off Martinique (lat. 14° 28′ 50″ N., long. 61° 05′ 40″ W.); 175 meters; temperature 16.11; sand and broken shells; February 10, 1879 [von Graff, 1884].

Blake; Montserrat, Dominica or Martinique (5, M. C. Z., 429).

Barbados; Captain Werner, 1873 [Hartlaub, 1912].

University of Iowa's Barbados-Antigua expedition station 50; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 51; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 70; Barbados [A. H. Clark, 1921] (arm fragments, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 79; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 85; Barbados [A. H. Clark, 1921] (part of an arm, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 92; Barbados [A. H. Clark, 1921] (arms, U. I. M.).

University of Iowa's Barbados-Antigua expedition; Barbados [A. H. Clark, 1921] (1, and fragments of another, U. I. M.).

Blake station 231; off St. Vincent (lat. 13° 12′ 10″ N., long. 61° 17′ 18″ W.); 174 meters; temperature 16.39° C.; sand and broken shells; February 20, 1879 [Hartlaub, 1912] (1, M. C. Z., 430).

Albatross station 2142; Gulf of Darien, southwest of Cartagena, Colombia (lat. 9° 30′ 15″ N., long. 76° 20′ 30″ W.); 77 meters; green mud and sand; March 25, 1884 (1+, U.S.N.M., 34530, 34531).

Albatross station 2146; northeast of Colon, Panama (lat. 9° 32′ 00″ N., long. 79° 54′ 30″ W.); 62 meters; broken shells; April 2, 1884 [A. H. Clark, 1917] (5+, U.S.N.M., 25458, 34498, 34499, 36251, 36277). Pl. 20, fig. 48.

Geographical range.—From northern Cuba to Barbados, St. Vincent, and the Gulf of Darien.

Bathymetrical range.—Sublittoral, and down to 355 meters; the average of 12 records is 203 meters, but undoubtedly the usual habitat is in shallower water.

Thermal range.—From 16.11° C. to 20.56° C.; the average of 4 records is 17.95° C.; but all these records are from deep water.

History.—The first reference to this species was published by Prof. Ludwig von Graff, who in one of his contributions on the myzostomes (1884) mentioned *Actinometra discoidea* from *Blake* stations 155 and 203 as a host. This name was furnished him by Dr. P. H. Carpenter, and occurs simply as a *nomen nudum*.

In the *Challenger* report (1888) Carpenter gave a specific formula for this species which was identical with that which he gave for *lineata* (*rubiginosa*). He inserted *discoidea* in his key to the species of the *Fimbriata* group of *Actinometra*, indicating that it differs from *lineata* (*rubiginosa*) in having the brachials "almost quadrate" instead of "triangular, nearly as long as wide." The range he gave as "Caribbean islands" in 88–118 fathoms.

In 1912 Hartlaub described this form in detail, with figures, under the name of *Actinometra echinoptera* var. *discoidea*. In his list of the varieties of *Actinometra echinoptera* and the localities where they were found he also mentioned it from *Blake* station 231 under the name of *Actinometra echinoptera* var. *rubiginosa-discoidea*, but no mention of this is made in the text. In addition to specimens from *Blake* stations 155, 177, 203, and 231, Hartlaub described in detail 2 examples from Barbados in the Kiel Museum which had been collected by Captain Werner in 1873.

In 1917 I described this species under the name of *Nemaster insolitus*, not having at that time seen Hartlaub's material and being uncertain as to just what he had.

In 1918 Dr. Hubert Lyman Clark recorded *Nemaster insolitus* from the University of Iowa's Bahamas expedition, but the specimen is really referable to *N. rubiginosa*.

In 1921 I recorded this form from a number of stations at Barbados, and also from Antigua, on the basis of the collection made by the University of Iowa's Barbados-Antigua expedition.

COMANTHOIDES, gen. nov.

Comanthus (part) H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 17.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, pp. 41, 42.

Comissia (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41.

Diagnosis.—A genus of Capillasterinae in which the outer cirrus segments are not carinate dorsally, the dorsal processes, including the opposing spine, being straight transverse ridges; the arms are 10 or more than 10 in number—usually 10 and never so many as 20; the IIBr series are 2, 4 (3+4), or 3 (2+3), usually 4 (3+4); the first pinnule on arms following the IIBr axillary is on the first or second brachial; the basal segments of the pinnules in the proximal half of the arm bear high and conspicuous spinous crests; on the undivided arms following a IIBr axillary the first syzygy is between brachials 2+3 or 3+4; following a IIBr 2 series there may be a syzygy between both brachials 1+2 and 3+4.

Geographical range.—Southeastern Australia and Bass Strait.

Bathymetrical range.—From 119 (?91) to 183 (?311) meters.

Remarks.—The single known species of this genus combines in a most curious way the characters of the genera *Comissia* and *Capillaster* of the Capillasterinae, and *Comanthus* of the Comasterinae.

There are usually 10 arms, and these 10-armed individuals very strongly resemble species of *Comissia*. If there are more than 10 arms the IIBr series are usually 4 (3+4) and the two arms following the IIBr axillary have the first pinnule on the second brachial and brachials 3+4 united by syzygy, as in *Comanthus*. But sometimes following a IIBr 4 (3+4) series the inner arm has a pinnule on the first brachial and a syzygy between brachials 2+3, as in *Capillaster*, while on the outer arm the first pinnule is on the second brachial and there is a syzygy between brachials 3+4, as in *Comanthus*. Following a IIBr 2 series, the inner arm in the same way may have a pinnule on the first brachial and a syzygy between brachials 2+3, while the outer arm has the first pinnule on the second brachial and the first syzygy between brachials 3+4. In some cases the IIBr series are 3 (2+3), like the IIIBr series in *Capillaster*—the only instance of IIBr 3 (2+3) series to be found anywhere in the comatulids. These IIBr 3 (2+3) series are followed inwardly by a *Capillaster*-like arm, and outwardly by a *Comanthus*-like arm.

In its pinnules and in its cirri *Comanthoides* agrees most closely with *Comissia*, and it seems best to regard it as an aberrant member of the Capillasterinae rather than as a connecting link between the Capillasterinae and the Comasterinae.

COMANTHOIDES SPANOSCHISTUM (H. L. Clark)

(Plate 21, Figures 52–57; Plate 22, Figure 58; Plate 23, Figure 63)

Comanthus spanoschistum H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, p. 17 (description; notes and comparisons; localities); pl. 4, fig. 3 (holotype; east of Flinders I., 100–300 fathoms).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41 (10-armed specimens referred to *Comissia*); p. 42 (specimens with more than 10 arms considered synonymous with *Comanthus tasmaniae*).

Comissia spanoschistum A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41 (listed from Tasmania); p. 42 (discussion).

Comanthus tasmaniae (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 42 (specimens with more than 10 arms referred to this species).

Description.—According to Dr. H. L. Clark, the centrodorsal is large and flat, in adults 5 mm. in diameter and about 1 mm. thick. The cirri are arranged in one and a partial second marginal rows.

The cirri are about XXIV, 15–20, the longest from 10 to 15 mm. in length. The fourth–seventh or third–eighth segments are cylindrical and are longer than broad; the fourth (or fifth) may be nearly twice as long as broad. Distally the segments are a trifle compressed, and the distal margin dorsally is elevated to form a low tubercle which, at least on the penultimate segment, is spiniform.

The radials are concealed. The IBr_1 are low and broad, more or less in contact laterally. The IBr_2 (axillaries) are triangular, high and pointed, half again as broad as long. The IBr series, when present, are 4 (3+4). There are no IIIBr series.

The arms are 10–19 in number, but usually 10. In the type series of 23 specimens one had 13, another 14, and a third 19 arms, the remaining 20 having 10 arms. The arms are from 30 to 80 mm. long. The brachials are at first quadrilateral, but soon become triangular. Their distal edges become more and more produced and overlapping until near the tips of the arms, where the brachials become quadrilateral again and the distal edges are scarcely produced.

Syzygies occur between brachials 3+4, and then at an interval of from 7 to 11 muscular articulations. After that the intersyzygial interval is usually 5, but may be only 3, muscular articulations.

The pinnules are long and slender. P_1 is over 10 mm. long and consists of about 30 segments, of which about 15 are involved in the formation of the comb. P_2 is somewhat smaller, and P_3 is only 8 mm. long and is composed of 20 segments, of which 9 are involved in the formation of the comb. P_4 is 8 mm. long and is without a comb. The succeeding pinnules become more slender and increase in length to about 10 mm. The basal segments of the lower pinnules are more or less triangular with greatly flaring spinulose margins which tend to project like rough spurs on the aboral side of the largest segments.

The disk is from 5 to 12 mm. in diameter, and except around the tip of the anal tube is smooth and naked. There are calcareous nodules on the anal tube. The mouth is interradial.

The color, both in alcohol and dry, is more or less yellowish, with either a green or a brown cast. One specimen is very dull purplish with yellow cirri; others are yellowish, more or less clouded with purplish; in the 19-armed individual the dull purplish predominates.

Notes.—There are in the collection of the Museum of Comparative Zoölogy 6 specimens of this species, 3 with 10, 1 with 11, 1 with 12, and 1 with 13 arms. The specimens with 11 and 12 arms are under No. 722, and that with 13 arms is under No. 723.

A 10-armed specimen from the coast of Gippsland may be thus described. The centrodorsal is broad, flat, thin discoidal, pentagonal, 3 mm. in diameter. The cirrus sockets are arranged in a single crowded regular marginal row.

The cirri are XVI, 14, 8 mm. long. The first segment is very short, the second is between half again and twice as broad as long, the third is usually one-third again as long as broad, sometimes as much as half again as long as broad, and the fourth is the longest, from half again to twice as long as broad. The fifth segment resembles the fourth, or is very slightly shorter; it is a transition segment, with the distal portion highly polished. The sixth segment is usually slightly, when at all, longer than the distal width, and those following decrease in length, the outer being markedly broader than long. The most highly developed cirri taper very slightly to just beyond the middle of the fifth (transition) segment; in lateral view they slowly broaden again from this point, as the distal segments are considerably compressed. The third–fifth segments have a slight central constriction. The fifth and following segments in lateral view are seen to have a minute dorsal tubercle, which at first is subterminal, later becoming median. In dorsal view the dorsal process is seen to broaden slowly distally, so that on the outermost segments it becomes a straight median transverse ridge. The opposing spine is represented by a transverse ridge with a straight crest.

The ends of the basal rays are visible as small, low tubercles in the interradial angles bridging over the exceedingly narrow subradial clefts.

The radials are visible as narrow slightly curved bands separating the IBr_1 from the centrodorsal. The IBr_1 are very short, about four times as broad as the median length, with the proximal border convex and the distal border straight. The lateral borders, which are very short, are in close apposition. The IBr_2 (axillaries) are sharply triangular, twice as broad as long, with all the sides nearly straight and the lateral angles sharp.

The 10 arms are 65 mm. in length. The earlier brachials have very finely serrate distal ends. As the brachials become trangular the distal ends become produced and armed with very numerous short fine spines. In the earlier pinnules the segments beyond the second have the outer edge much produced and armed with conspicuous, though short, spines. These spinous crests are highest on the third and fourth segments and disappear after the sixth or seventh. Besides this, the entire distal border of the segments is somewhat produced and very spinous. After the proximal half of the arm the crests on the earlier pinnule segments become less conspicuous, but traces of those on the third and fourth segments persist to the arm tips. The distal pinnules have an unusual development of small spines, and the dorsal spines on the last 4 or 5 segments are unusually long and conspicuous. The terminal comb consists of 6–8 teeth, beyond which is a short, smooth tip. The teeth are double, being almost equally developed on each side of the segments.

Another 10-armed specimen has the arms 100 mm. in length. The centrodorsal is rounded pentagonal, 3 mm. in diameter, very thin discoidal. The cirri are XVIII, 15. The terminal comb on the lower pinnules has 8–12 (usually 8–10) teeth.

A third 10-armed specimen has the arms about 65 mm. long. The cirri are XX, 15–16. The terminal comb has 8–12 (usually 8–9) teeth.

Another 10-armed individual has the cirri XXII, 13–14 (usually 14).

There are 7 additional 10-armed specimens from this locality.

A specimen with 11 arms has a single IIBr 2 series. Of the 2 arms arising from the IIBr axillary the inner has the first syzygy between brachials 2+3 and the outer has the first syzygy between brachials 3+4. On the inner arm the first brachial bears a pinnule, while on the outer arm the first pinnule is on the second brachial.

Another specimen with 11 arms has a single IIBr 4 (3+4) series. Of the 2 arms arising from the IIBr axillary the inner has the first syzygy between brachials 2+3 and the first pinnule on the first brachial, while the outer has the first syzygy between brachials 3+4 and the first pinnule is on the second brachial.

In another specimen with 11 arms and a single IIBr 4 (3+4) series, both arms arising from the IIBr axillary have the first syzygy between brachials 3+4 and the first pinnule on the second brachial. Two other 11-armed individuals are similar to this.

In a specimen with 12 arms there are 2 IIBr 4 (3+4) series. The first pinnule is in all cases on the second brachial. On 3 of the arms arising from the IIBr axillaries the first syzygy is between brachials 3+4, but on one of the inner arms it is between brachials 10+11.

Another example has 12 arms and 2 IIBr 4 (3+4) series. All 4 of the arms following the IIBr axillaries have the first pinnule on the second brachial and the first syzygy between brachials 3+4. Another 12-armed specimen with 2 IIBr 4 (3+4) series is similar to this.

In a specimen with 12 arms there are 2 IIBr 4 (3+4) series. Following one of the IIBr axillaries, the inner arm has the first syzygy between brachials 3+4 and the first pinnule on the second brachial, while the outer has the first syzygy between brachials 1+2 and the second between brachials 10+11, and the first pinnule on the epizygal of the first syzygial pair (second brachial). The 2 arms following the other IIBr axillary both have the first syzygy between brachials 3+4 and the first pinnule on the second brachial.

A very interesting specimen with 12 arms has one IIBr 4 (3+4) series and one IIBr 3 (2+3) series. Following the axillary on the IIBr 4 (3+4) series, the outer arm has the first syzygy between brachials 6+7 and the inner arm has the first syzygy between brachials 3+4; on both arms the first pinnule is on the second brachial. Following the axillary on the IIBr 3 (2+3) series, the inner arm has the first syzygy between brachials 2+3 and the first pinnule on the first brachial, while the outer arm has the first syzygy between brachials 3+4 and the first pinnule on the second brachial.

Two specimens with 13 arms have 3 IIBr 4 (3+4) series. On all the arms following IIBr axillaries the first syzygy is between brachials 3+4 and the first pinnule is on the second brachial.

In a specimen with 14 arms there are 4 IIBr 4 (3+4) series. On all of the arms following the IIBr axillaries the first syzygy is between brachials 3+4 and the first pinnule is on the second brachial.

Localities.—Endeavour; southwest of Rame Head, Gippsland, Victoria (lat. 38° 07′ S., long. 149° 10′ E.); 128–155 meters; sand; September 10, 1914 (24). Pl. 21, figs. 52–57; pl. 22, fig. 58; pl. 23, fig. 63.

Endeavour; Bass Strait, east of Babel Island; 109–128 meters, and 91–146 meters [H. L. Clark, 1916].

Endeavour; Bass Strait, northeast of Babel Island; 183–311 meters [H. L. Clark, 1916].

Endeavour; Bass Strait, 20 miles east of Babel Island; 119 meters [H. L. Clark, 1916].

Endeavour; Bass Strait, east of Flinders Island; 128–183 meters [H. L. Clark, 1916] (2, M. C. Z., 711).

Endeavour; Bass Strait, eastern slope; 128–219 meters [H. L. Clark, 1916] (2, M. C. Z., 722).

Endeavour; east of Maria Island, Tasmania; 142 meters [H. L. Clark, 1916] (2, M. C. Z., 723).

Geographical range.—Southeastern Australia and Bass Strait.

Bathymetrical range.—From 119 (?91) to 183 (?311) meters.

History.—This species was first described by Dr. H. L. Clark in 1916 from specimens collected by the Australian Fisheries Investigations steamer *Endeavour* in Bass Strait, between Australia and Tasmania.

From Doctor Clark's description I supposed that he had confused 2 species, one of *Comissia* and another of *Comanthus*, and I thought I recognized in the specimens with more than 10 arms a form from Tasmania with which I was already familiar.

So in 1918 I listed the 10-armed specimens described by Doctor Clark under the name of *Comissia spanoschistum* and referred those with more than 10 arms to my new *Comanthus tasmaniae*—a procedure which should have been reversed, since the holotype of *Comanthus spanoschistum* is a multibrachiate individual.

Recently I received from Dr. Th. Mortensen a fine series of 24 specimens from the Gippsland coast collected by the *Endeavour* on a cruise during which Doctor Mortensen was on board. A study of these has brought out several wholly unexpected and extraordinary features connected with this species, and has shown that Doctor Clark was correct in assuming that all his specimens represented a single form.

Remarks.—The systematic position of this species is most puzzling, for it combines in a most singular way features characteristic of the genera *Comissia*, *Comatella*, *Capillaster*, and *Comanthus*.

Genus COMISSIA A. H. Clark

Actinometra (part) BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 510, and following authors.

Comaster (part) A. H. CLARK, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 202.

Comissia A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 501 (diagnosis; genotype *Comissia lütkeni*); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Capillasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 151 (comparison with *Cominia*); p. 193 (probably occurs at Singapore, though not yet discovered there); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represented in the West Indies by *Leptone-*

master); p. 13 (common to southeast Africa and Ceylon, but not found in the Arabian Sea); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (discussion; list of known species); Amer. Journ. Sci., ser. 4, vol. 32 (old ser. vol. 182), No. 188, Aug. 1911, p. 129 (appears to have given rise to the West Indian *Comatilia*, *Microcomatula*, and *Leptonemaster*); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 725 (absent from Australia); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia); p. 10 (absent from Japan; reason); p. 11 (represented in the Ceylon region); p. 12 (represented in the southeast African region); p. 20 (bathymetric range); p. 55 (in key); p. 77 (original reference; type); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 3 and following (represented in the Atlantic by *Leptonemaster* and *Comatilia*; range); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echin. II, Crinoidea, 1914, p. 309 (corresponds to *Leptonemaster*); Die Crinoiden der Antarktis, 1915, p. 181 (range; represented in the Atlantic by *Leptonemaster* and *Comatilia*); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 3 (in key); p. 19 (key to the included species); Journ. Washington Acad. Sci., vol. 9, No. 5, 1919, p. 136 (disk compared with that of *Holopus*).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 97 (pinnule articulations).

Comanthus (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, pp. 8, 18, 19; vol. 43, 1912, p. 385.—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 17.

Comanthus (*Validia*) (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, pp. 18, 19.

Diagnosis.—A genus of Capillasterinae including species in which the arms are 10 in number; there are no prominent carinate processes on the basal segments of the earlier pinnules; all the pinnules are present; the pinnules of the first 2, 3, or 4 pairs have terminal combs which are confined to the distal half and are composed of teeth which are seldom, and never much, higher than the width of the segments bearing them; none of the segments of the proximal pinnules are more than slightly longer than broad; there is no modification of the dorsal surface of the lower brachials; the brachials and pinnule segments have very spinous distal ends; the cirri are never excessively slender; and the arms are always more than 20 mm. in length.

Geographical range.—From the Seychelles, Amirante Islands, Red Sea, and Ceylon to northern and eastern Australia and Tasmania, the Bonin Islands, southern Japan, the Philippines, and Macclesfield Bank.

Bathymetrical range.—From the shore line down to 984 meters.

Thermal range.—From the warm surface water of tropical seas down to 13.7° C.

Remarks.—The species of *Comissia* vary from rather large, with the arms 170 mm. long and 25–30 cirrus segments, to very small, with the arms not more than 30 mm. long and only 9–11 cirrus segments.

Some of the species are very spiny, while others are smooth. Some have weak and slender cirri with elongate segments, while in others the cirri are stout and strongly recurved in the distal half. In some the arm bases are almost at right angles with the dorsoventral axis, so that the arms lie practically in the same plane, while in others the arm bases make a rather sharp angle with the dorsoventral axis.

Taken as a whole *Comissia* is a rather heterogeneous assemblage, and some of the species groups within it seem to have little in common with others beyond the possession of only 10 arms.

We know so little about most of the included species that any more detailed generalization at the present time would be premature.

KEY TO THE SPECIES IN THE GENUS COMISSIA

- a^1. More than 25 cirrus segments.
  - b^1. Cirri numerous, XXX–XL; arms 150–170 mm. long (Bonin Islands; 183 meters). **magnifica**, p. 247.
  - b^2. Cirri few, XIII–XV; arms 100–120 mm. long (Philippine Islands and Macclesfield Bank; 100–110 meters) ---- **peregrina**, p. 248.
- a^2. Not more than 25 cirrus segments.
  - b^1. Cirrus segments 16–24 in number.
    - c^1. Fourth and following cirrus segments with the distal dorsal and dorsolateral edge everted and finely spinous, this on the last 2 or 3 becoming a single blunt spine or tubercle; fourth (occasionally the fifth) a strongly marked transition segment; P_4 with a comb (Lesser Sunda Islands to Queensland and the Philippines; 29–135 meters) ---- **lütkeni**, p. 249.
    - c^2. Outer cirrus segments simply with a low subterminal tubercle; no strongly marked transition segment; P_4 without a comb (Bass Strait; 119 [?91]–183 [?311] meters). [**Comanthoides spanoschistum**, p. 241].
  - b^2. Not more than 16 cirrus segments.
    - c^1. Cirrus segments 14–16 in number.
      - d^1. Longest cirrus segments three to four times as long as broad; cirri XVII, 14–15, 10 mm. long; cirri arranged in 2 irregular rows on the centrodorsal; elements of the division series with slightly prominent and finely spinous distal ends; brachials with strongly overlapping and very spinous distal edges; arms 55 mm. long (Philippines; 106 meters). **horridus**, p. 254.
      - d^2. Longest cirrus segment not more than twice as long as broad.
        - e^1. Cirri arranged in 3 closely crowded marginal rows; P_1 with a comb of about 25 exceptionally long teeth; P_4 with a comb of 15–16 teeth; arms about 90 mm. long (Christmas Island and the Kei Islands) ---- **pectinifer**, p. 255.
        - e^2. Cirri in a single marginal row; P_1 with a comb of 9–11 teeth; P_3 and the following pinnules without combs; arms about 60 mm. long; cirri 10–11 mm. long (Karkaralong and Philippine Islands) ---- **littoralis**, p. 256.
    - c^2. Not more than 14 cirrus segments.
      - d^1. Arms about 60 mm. long.
        - e^1. Cirrus segments 12–14, the longest from two to two and one-half times as long as the proximal width (Ceylon; 51–183 meters) ---- **chadwicki**, p. 257.
        - e^2. Not more than 12 cirrus segments, the longest about four times as long as the proximal width.
          - f^1. Cirrus segments 10–12 in number; cirri 5–6 mm. long, with the penultimate segment twice as broad as long; IBr_1 about four times as broad as long, in lateral apposition; axillaries twice as broad as long; P_1 7 mm. long with about 25 segments, the terminal comb with 7–8 small and well separated teeth and similar, but smaller teeth on the opposite side of the segments; P_4 without a comb (Philippines; 106 meters). **scitulus**, p. 274.
          - f^2. Cirrus segments 9–10 in number; cirri 8 mm. long, with the penultimate segment about as long as broad; IBr_1 six to eight times as broad as long; axillaries not greatly broader than long; P_1 12–14 mm. long with 40 segments, the terminal comb with 15–17 long curved teeth which are set very close together basally; combs occur as far as P_6 (Palawan to the Kei Islands; 90–93 meters) -- **hispida**, p. 258.
      - d^2. Arms not more than 45 mm. long.
        - e^1. More than XX (XX–XXX) cirri, which are 7–9 mm. long; arms 45 mm. long.
          - f^1. Elements of the division series, brachials and pinnule segments with strongly produced distal edges which are armed with prominent spines (Korean Straits to the Lesser Sunda Islands; 113–210 meters) ---- **spinosissima**, p. 259.
          - f^2. Edges of the ossicles of the division series smooth and not produced; edges of the brachials and pinnule segments not unusually spinous (southern Japan to the Kei and Lesser Sunda Islands; 73–731 meters) ---- **parvula**, p. 262.

e^3. Less than XX cirri.

  f^1. Antepenultimate cirrus segment half again as long as broad, and the penultimate segment about as long as broad (southern Japan to the Kei Islands; 595–984 meters) ---------- **gracilipes**, p. 265.

  f^2. Antepenultimate cirrus segment only slightly, if at all, longer than broad.

    g^1. Cirri VIII–XIV (usually about X), 10–13 (usually 12–13); longest cirrus segment from three and one-half to four times as long as the median width (Gulf of Suez). **hartmeyeri**, p. 267.

    g^2. Cirri XII–XX (usually XII–XVI), 8–12 (usually 9–11); longest cirrus segment about three times as long as the median width.

      h^1. Arms 30–53 mm. long; cirri 4–5 mm. long; not more than XV cirri (Amirante Islands and Seychelles; 31 meters) ---------- **ignota**, p. 269.

      h^2. Arms not more than 30 mm. long; cirri not more than 4 mm. long; usually more than XV cirri (Bonin Islands; 128–210 meters) ---------- **minuta**, p. 270.

COMISSIA MAGNIFICA Gislén

Comissia peregrina var. *magnifica* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (192 m.).

Comissia peregrina magnifica Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser 4, vol. 5, No. 6, 1922, p. 6 (Bonin Is.); Zool. Bidrag från Uppsala, vol. 9, 1924, p. 76 (syzygial faces); fig. 62, p. 75 (syzygial face of the third brachial).

Comissia peregrina var. *magnifica* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 21 (Bock's station 59; description and discussion), figs. 10, 11, p. 28; pl. 1, fig. 2.

Diagnostic features.—The large size, the arms being from 150 mm. to 170 mm. long, and the numerous cirri, which are XXX–XL, seem to distinguish this species from all the others in the genus.

Description.—In one of the 2 specimens described by Gislén the centrodorsal is pentagonal with the angles somewhat produced, 5.5 mm. in diameter and 1.5 mm. high; the bare dorsal pole is 2.5 mm. in diameter. The cirrus sockets are arranged in 2 rows.

The cirri are XXXV–XL, all broken.

The radials are visible as small triangles in the interradial angles of the calyx. The IBr_1 are very short, six times as broad as long, laterally in contact. The IBr_2 (axillaries) are three times as broad as long, low pentagonal. There is a low synarthrial tubercle on the articulation between the elements of the IBr series.

The 10 arms are from 150 to 170 mm. in length. If the first 2 syzygial pairs are counted as single units there are 16 brachials to 10 mm. of arm length. The width of the arms is from 2.5 to 1.3 mm. The first brachials are interiorly united. The second brachials are three times as long exteriorly as interiorly. The first syzygial pair (composed of brachials 3 + 4) is very short and bandlike. There is a weak articular tubercle between brachials 4 and 5 on the inner side of the arm. Between brachials 5 and 6 there is a similar articular tubercle on the outer side of the arm. Between the sixth-seventh and eighth-ninth brachials there are rounded knobs on the inner side of the arms, and between the seventh-eighth and ninth-tenth similar knobs on the outer side of the arms. The succeeding brachials are rounded with more or less oblique articulations. The profile of the arms is proximally somewhat serrate, but distally smooth.

Syzygies occur between brachials 3 + 4, 13 + 14, and 17 + 18, and distally at intervals of 3 or 4 muscular articulations.

P_1 is 17 mm. long and is composed of 50–55 segments. The second-seventh or -eighth segments have slight rounded dorsal processes. The remaining segments are smooth with the distal edge slightly produced, and are not at all or only slightly longer than broad. The 22–25 terminal segments bear large rather pointed teeth which in height equal the width of the segments which bear them. P_2 is 13 mm. long. P_3 and P_4 are somewhat shorter and bear combs. P_5 is 12 mm. long with 27 segments and is without a comb. The distal pinnules are 12 or 13 mm. in length and are composed of 25–28 segments. The first 20–25 pairs of pinnules have the proximal segments distally somewhat everted and bearing small spines. The segments of the distal pinnules are somewhat constricted centrally and have distinctly spinous ends. The terminal pinnulars are provided with weak hooks.

The disk is 11 mm. in diameter and bears small calcareous granules. The mouth is subcentral. The anal funnel is marginal, small and short, 2 mm. in height.

The color in formalin is yellowish brown.

In the second specimen the centrodorsal is flatter and more nearly circular in outline, 5.5 mm. in diameter. The cirrus sockets are arranged in a partially double row.

The cirri are broken. The number is about XXX. There remain 5 segments of a cirrus. These slowly increase in length, the fifth segment being about two-thirds as broad as long and slightly constricted centrally.

The 10 arms are 145 mm. long, most of them being broken. As in the other specimen, there are 16 brachials to 10 mm.

The distal intersyzygial interval is 3 muscular articulations.

P_1–P_4 bear combs. P_4 is 12 mm. long and its comb consists of 22 teeth. The distal pinnules are 14 mm. long with about 30 segments.

Locality.—Dr. Sixten Bock's station 59; Bonin Islands, eastnortheast of Anojima; 183 meters; 1914 [Gislén, 1922, 1924].

Remarks.—This species is only known from the 2 specimens collected by Doctor Bock in 1914 and described by Gislén in 1922.

COMISSIA PEREGRINA (Bell)

Plate 24, Figure 65

[See also vol. 1, pt. 1, fig. 56 (comb), p. 83; pt. 2, figs. 387, 388 (pinnule tip), p. 245]

Actinometra peregrina Bell, Proc. Zool. Soc. London, 1894, pp. 396, 402 (description; Macclesfield Bank, 55–60 fathoms).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 38 (identity); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 6 (same; redescription).

Comissia peregrina A. H. Clark, Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (listed, with habitat); Crinoids of the Indian Ocean, 1912, p. 38 (identity); p. 77 (synonymy; detailed description of the type; habitat); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 6 (reference to the specimen in the British Museum; locality; redescription); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range; includes *C. dumetum*).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 22 (comparison with *C. p. magnifica*).

Comissia dumetum A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 531 (description; *Albatross* station 5356); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (listed, with habitat); Crinoids of the Indian Ocean, 1912, p. 77 (synonymy; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19, footnote 1 (=*C. peregrina*).

Diagnostic features.—The size is large, though not so large as in *C. magnifica*, the arms being from 100 to 120 mm. in length; there are only XIII–XV cirri, which have 25–30 segments.

Characters of the type specimen.—The cirri are XIII, 25–30 (usually nearer the latter), 20 mm. long. Professor Bell notes that the fifth and sixth segments seem to be distinctly the longest. The fifth is a transition segment.

The 10 arms are 120 mm. long. The synarthrial tubercles are only slightly evident. The distal edges of the brachials are moderately produced and finely spinous.

According to Professor Bell the first syzygy is between brachials 3+4, the second is between brachials 12+13, and the third is between brachials 20+21. The distal intersyzygial interval is 3 muscular articulations.

There is a great development of small spines, especially on the pinnule segments, so that the animal has a curiously "dry" feeling.

The color in alcohol is brownish.

Notes.—In the type specimen of *Comissia dumetum* the cirri are XV, 26–27, from 15 to 17 mm. in length. Compared with the cirri of *C. lütkeni* they are more slender, with the longer proximal segments somewhat more strongly constricted centrally and the distal segments with the dorsal processes slightly more pronounced.

The 10 arms are about 100 mm. long.

The pinnules resemble those of *C. lütkeni*, but the distal ends of the segments are more prominent and more spinous, and the dorsal surface is much more spinous. The spine at the ventral distal angles of the segments of the middle and distal pinnules is much longer than the corresponding spine in *C. lütkeni* and somewhat more slender; on the outer segment its length is equal to the width of the segment bearing it; it may be more or less branched, especially at the tip.

The color is olive green, the cirri blotched with lighter.

Localities.—Macclesfield Bank, west of Luzon, Philippines; 100–110 meters [Bell, 1894; A. H. Clark, 1912, 1913, 1918] (1, B. M.).

Albatross station 5356; north Balabac Strait, Philippines; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long., 117° 18′ 45″ E.); 106 meters; temperature 27.78° C.; sand and shells; January 5, 1909 [A. H. Clark, 1911] (10, U.S.N.M., 27484, 34936, 34943). Pl. 24, fig. 65.

Remarks.—Bell's original description published in 1894 is indefinite and in part inaccurate. I reexamined his type specimen in London in 1910 and published notes upon it in 1913.

There can, I think, be no doubt that my *Comissia dumetum* described in 1911 is the same as Bell's *Actinometra peregrina*.

COMISSIA LÜTKENI A. H. Clark

Plate 24, Figs. 66, 67

[See also vol. 1, pt. 2, fig. 242 (arm), p. 197]

Comaster coppingeri (part) A. H. CLARK, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 202 (*Albatross* station 5153; 10-armed specimens).

Comissia lütkeni A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 502 (description; *Albatross* station 5153); vol. 39, 1911, p. 531 (*Albatross* station 5483; compared with *C. dumetum* [*peregrina*]); p. 532 (compared with *C. hispida*); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (arms compared with those of *C. pectinifer;* listed, with habitat); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 19 (arms compared with those of *C. littoralis*); Crinoids of the Indian Ocean, 1912, p. 77 (synonymy; range); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range); p. 20 (description; stations 260, 305); pp. 275, 276 (listed).

?*Comanthus spanoschistum* (part) H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, p. 17 (off Noosa Head, Queensland, 16 fathoms).

Diagnostic features.—The cirri are XV–XXV, 16–24 (usually 18–21), from 7 to 17 mm. long; the fourth and following cirrus segments have the dorsal and dorsolateral portion of the distal edge everted and finely spinous, this eversion on the last 2 or 3 becoming a single blunt spine or tubercle; the fourth (or occasionally the fifth) cirrus segment is a strongly marked transition segment. P_4 bears a comb. The arms are from 70 to 75 mm. in length.

In spite of the wholly different character of the cirri, this species is rather easily confused with *Comatula pectinata.*

Description.—The centrodorsal is discoidal, with the bare polar area broad and flat, 4 or 5 mm. in diameter. The cirrus sockets are arranged in two closely crowded alternating rows.

The cirri are XV–XXV, 16–24 (usually 18-21), from 7 to 17 mm. long, relatively small and rather stout. The first segment is over twice as broad as long, the second and third are nearly or quite as broad as long, the fourth is from half again to nearly twice as long as broad, and is a transition segment, usually rather darker than the preceding proximally, but light colored and with a polished surface in the distal fourth. The following segments decrease in length, after the eighth being about twice as broad as long. Occasionally the fifth is a transition segment instead of the fourth, in which event the two are of about the same size. The fourth and following segments have the distal dorsal and dorsolateral edge everted and finely spinous; this eversion of the distal edge of the segments gradually narrows anteriorly, on the last two or three segments becoming merely a single blunt spine or tubercle; concurrently with its narrowing it gradually attains a crescentic form, so that in lateral view the segments from the fourth onward appear to be furnished with low dorsal spines which arise gradually from the entire dorsal surface, with the apex at first terminal, gradually becoming subterminal in position, and on the antepenultimate segment almost median. The opposing spine is median, arising from the entire dorsal surface of the penultimate segment, short, and blunt, reaching not more than one-third the distal diameter of that segment in height. The terminal claw is about as long as the penultimate segment, stout, and moderately curved.

The ends of the basal rays are visible as prominent tubercles in the angles of the calyx.

The radials are quite concealed, or a small portion is visible over the ends of the basal rays. The IBr_1 are short and broad, closely united laterally, more or less concealed by the centrodorsal. The IBr_2 (axillaries) are triangular, about twice as broad as long, free laterally. The synarthrial tubercles are prominent.

Arms 10, from 70 to 75 mm. long. The first brachial is short, slightly wedge-shaped, between three and four times as broad as long exteriorly, interiorly united.

The second brachial is larger and much more obliquely wedge-shaped. The first syzygial pair (third and fourth brachials) is somewhat longer interiorly than exteriorly, about twice as broad as the interior length. The following 1 or 2 brachials are almost oblong, about three times as broad as long, then becoming triangular, about twice as broad as long, and in the terminal part of the arm very obliquely wedge-shaped, about as long as broad. The brachials after the second have prominent and finely spinous distal ends and a very finely tubercular or spinous dorsal surface, which in the terminal portion gradually become obsolete, so that the ends of the arms are practically smooth.

Syzygies occur between brachials 3+4, again between brachials 11+12 to 14+15, and distally at intervals of 3 muscular articulations.

P_1 is from 12 to 15 mm. long, slightly stouter than the succeeding pinnules, though not especially large, with about 35 segments which at first are about twice as broad as long, very gradually becoming longer, and about as long as broad after the twelfth or fifteenth. The terminal comb is prominent, arising abruptly, composed of 16 teeth which are bluntly triangular, nearly twice as long as broad at the base, basally in apposition, about as high as the height of the segments which bear them, and rather strongly recurved. P_2 is similar, from 10 to 12 mm. long. P_3 is similar, from 8 to 10 mm. long. P_4 is 6 mm. long. P_5 and the following pinnules are 6 mm. long, without combs, composed of 16 segments, of which the first 3 are not so long as broad and the remainder are about as long as broad. Distally the pinnules gradually increase in length and become more slender, the outer pinnules being 8 mm. long with from 23 to 25 segments, of which the first 2 are short, the third and following longer than broad, and the outer about twice as long as broad. The lower pinnules have the corners of the component segments considerably cut away. The segments of the middle and distal pinnules are slightly constricted centrally with a finely spinous surface and with the distal ends produced ventrally into two long sharp spines, one on either side of the perisome; this modification of the segments in the more proximal of the middle pinnules affects only the distal portion, later encroaching more and more upon the proximal part and soon involving almost all the segments.

The lateral perisome of the pinnules is almost naked, containing merely a few very slender and inconspicuous, usually widely scattered, spicules.

The disk is naked, or with small scattered calcareous granules. The mouth is subcentral and the anal tube is small and marginal.

Notes.—Speaking of the specimen recorded as *Comanthus spanoschistum* from off Noosa Head, Queensland, Dr. H. L. Clark says that it "is noticeably more slender than the others and the cirri are somewhat more compressed, but these differences are very slight and no more than one might expect in view of the wide separation of Noosa Head from the Tasmanian waters, where this species [*Comanthoides spanoschistum*] seems to be so common."

The specimen from *Siboga* station 260 has the arms about 100 mm. long and the cirri XIV, 23–25, about 15 mm. long.

One of the specimens from the Danish expedition to the Kei Islands station 24 may be described as follows.

The centrodorsal is discoidal, rather thick, with the slightly convex dorsal pole 3 mm. in diameter. The cirrus sockets are arranged in a single fairly regular marginal row. These are deep, and as a rule the lateral borders are more or less straight and may be slightly elevated as a low narrow ridge.

The cirri are XIII, 17, 9 mm. long. The first segment is three times as broad as long, or even shorter; the second is from half again to twice as broad as long; the fourth is twice as long as the median width and is a transition segment. The fifth is about half again as long as the median width, and the seventh and following are about as long as the basal width. The transition segment is slightly constricted centrally, and the distal end is enlarged. On the dorsal side the distal edge is slightly everted and is armed with exceedingly fine spinules. On the segment succeeding, the distal edge dorsally is much more strongly produced, so that the distal end of the segment is about one-third again as long as the proximal end of the next following, the difference representing the height of the elevation. On the next segment the everted distal end becomes gabled in the middle. On the succeeding segments the distal end of this gable moves proximally, so that the outer segments when viewed laterally show a high curved and very spiny crest running from near the proximal to the distal end. In dorsal view this crest is seen to be one of the sides of a deep V, which extends from the distal end of the segments to more or less near the proximal end. The opposing spine in lateral view is triangular, erect, arising from the entire surface of the penultimate segment, and equal to nearly half the width of the segment in height. Its apex is transversely elongated. The terminal claw is scarcely longer than the penultimate segment and is stout and strongly curved.

The ends of the basal rays are visible as small interradial tubercles. The radials are concealed in the median line, but a small portion of their anterolateral angles is visible over the ends of the basal rays. The IBr_1 are very short, from six to eight times as broad as long in the median line; the proximal border is somewhat convex and the distal border is straight. The IBr_2 (axillaries) are triangular, from two and one-half to three times as broad as long. The lateral angles are slightly truncated, and the distal angle is a right angle. The IBr_1 are laterally united in their proximal half or two-thirds, but the axillaries are widely free laterally.

The 10 arms are 80 mm. long. The first brachial is short, slightly longer exteriorly than interiorly, from six to eight times as broad as the median length, with the proximal and distal edges straight and almost parallel; interiorly the two first brachials of each arm pair are united in the basal portion, or in the basal half, beyond which their inner sides make usually a right angle with each other. The second brachials are almost triangular, the outer side being twice as long as the outer side of the first and the inner less than half as long as the inner side of the first. Both the first and second brachials have the distal edge slightly everted and armed with very fine spines, and the distal portion of the dorsal surface of the second brachials is marked with numerous very fine more or less parallel longitudinal ridges. The first syzygial pair (composed of brachials $3+4$) is approximately oblong and is about three times as broad as long. The syzygial line is slightly raised and is finely spinous, and the distal portion of the dorsal surface of the hypozygal is marked with numerous fine ridges. The distal edge of the epizygal is finely spinous. The next 2 brachials are roughly oblong, about four times as broad as long, with finely spinous distal ends, and those following soon become triangular, half again as broad as long, with the distal ends projecting and finely spinous and the distal portion of the dorsal surface finely striated. The brachials retain their triangular shape until about the last quarter of the arm, when they become very obliquely quadrate and finally elongate.

P_1 is the longest pinnule, 11 mm. long with 34 segments, of which the last 12 or 13 bear large incurved lanceolate teeth. P_2 is shorter and less stout than P_1, and P_3 is shorter and less stout than P_2. The middle and distal pinnules have the distal ends everted and strongly spinous.

The larger example from *Siboga* station 305 has the arms about 100 mm. long and the cirri XIX, 21–25 (usually 22–23), 17 mm. long; the fourth cirrus segment is a transition segment. The distal intersyzygial interval is 3 muscular articulations. The other specimen is similar but slightly smaller; the single complete cirrus has 20 segments, of which the fourth is a transition segment.

All 3 of the *Siboga* specimens are considerably larger than the 2 *Albatross* specimens from which the species was originally described, though otherwise resembling them.

Localities.—Albatross station 5483; between Samar and Leyte, Philippines, in the vicinity of Surigao Strait; Cabugan Grande Island (N.) bearing N. 88° W., 5.7 miles distant (lat. 10° 27′ 30″ N., long. 125° 19′ 15″ E.); 135 meters; temperature 28.34° C.; sand and broken shells; July 30, 1909 [A. H. Clark, 1911] (2, U.S.N.M., 34915). Pl. 24, fig. 67.

Albatross station 5153; Tawi Tawi group, Sulu (Jolo) Archipelago; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5° 18′ 10″ N., long. 120° 02′ 55″ E.); 89 meters; temperature 26.67° C.; coral sand and shells; February 19, 1908 [A. H. Clark, 1908, 1909] (3, U.S.N.M., 25513, 34914, 35950). Pl. 24, fig. 66.

Siboga station 260; 2.3 miles N. 63° W. from the north point of Nuhu Jaan, Kei Islands (lat. 5° 36′ 30″ S., long. 132° 55′ 12″ E.); 90 meters; sand, coral, and shells; December 16 and 18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 24; 100 meters; hard bottom; April 15, 1922 (4).

Siboga station 305; mid-channel in Solor Strait, off Kampong Menanga; 113 meters; stony bottom; February 8, 1900 [A. H. Clark, 1918] (2, U.S.N.M., E. 421; Amsterdam Mus.).

Endeavour; off Noosa Head, Queensland; 29 meters [H. L. Clark, 1916].

History.—Among the specimens which I recorded in 1908 from *Albatross* station 5153 under the name of *Comaster coppingeri*, two had only 10 arms. Further study showed that these in reality have nothing to do with that form, but instead represent an entirely different type, which in 1909 I described in detail under the name of *Comissia lütkeni*.

In 1911 two more specimens were recorded from *Albatross* station 5483.

Dr. Hubert Lyman Clark in 1916 recorded, as *Comanthus spanoschistum*, a specimen from off Noosa Head, Queensland, which seems undoubtedly to be this species.

In 1918 I recorded this form from two *Siboga* stations, giving notes on the specimens.

COMISSIA HORRIDUS (A. H. Clark)

Plate 24, Figure 68

Comaster (?) *horridus* A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 533 (description; *Albatross* station 5356).

Comissia horridus A. H. Clark, Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (listed, with habitat); Crinoids of the Indian Ocean, 1912, p. 77 (synonymy; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range).

Diagnostic features.—The cirri are XVII, 14–15, 10 mm. long, with the longest segment three or four times as long as broad. The arms are 55 mm. long. The elements of the division series have slightly prominent and finely spinous distal ends, and the brachials have strongly overlapping and very spinous distal ends.

Description.—The centrodorsal is thin discoidal, with the bare polar area 1 mm. in diameter. The cirrus sockets are arranged in a single closely crowded irregular marginal row.

The cirri are XVII, 14–15, 10 mm. long. The first segment is short, the second is somewhat longer than broad, the third is twice as long as the width of its expanded ends, and the fourth or fifth is the longest, two and one-half or three times as long as its expanded distal end. The next segment is very slightly shorter, and usually a transition segment. The following segments decrease in length so that the distalmost 3 or 4 are about as long as broad and the penultimate somewhat broader than long. The transition and following segments have minute median subterminal dorsal tubercles. The terminal claw is half again as long as the penultimate segment, slender, and moderately curved. The second and following segments have expanded ends. The earlier segments are well rounded in cross section, after the fifth becoming flattened laterally and much broader in lateral view.

The distal ends of the radials are even with the edge of the centrodorsal in the median line, but extend well up in the interradial angles of the calyx, where they entirely separate the bases of the IBr_1. The IBr_1 are oblong or slightly trapezoidal, twice as broad as long, and widely separated laterally. The IBr_2 (axillaries) are pentagonal, about as broad as long, with the lateral edges slightly shorter than those of the IBr_1 and making with them a broadly obtuse angle.

The 10 arms are about 55 mm. long. The first brachials are almost oblong, about twice as broad as the exterior length, interiorly in contact basally. The second brachials are of about the same size, but are longer exteriorly and shorter interiorly. The first syzygial pair (composed of brachials 3+4) is about as long as broad. The next 2 brachials are approximately oblong, half again as long as broad, and those following become obliquely wedge-shaped, somewhat longer than broad, gradually increasing in length distally, the terminal brachials being twice as long as broad. The elements of the IBr series have slightly prominent and finely spinous distal ends. After the sixth the brachials develop strongly overlapping and very spinous distal edges.

P_1 is 10 mm. long with about 39 segments, of which those after the fourth are about as long as broad. The long terminal comb consists of about 25 long curved teeth which are set closely together. P_2 is 6 mm. long with a similar comb. P_3 is 6 mm. long with a comb consisting of 18 teeth. P_4 is very slender, 6 mm. long, with a comb of

21 teeth which occupies rather more than its distal half. P_5 is very slender and delicate, 4 mm. long, without a comb. The following pinnules gradually increase in length, the distal pinnules, which are very slender with greatly elongated segments, being 6 mm. long.

Locality.—*Albatross* station 5356; north Balabac Strait; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long. 117° 18′ 45″ E.); 106 meters; temperature 27.78° C.; sand and shells; January 5, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 27487). Pl. 24, fig. 68.

Remarks.—This species is as yet known only from the type specimen.

COMISSIA PECTINIFER A. H. Clark

Plate 25, Figures 69, 70

Comissia pectinifer A. H. Clark, Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (description; Christmas I.); Crinoids of the Indian Ocean, 1912, p. 78 (detailed description; Christmas I.); Smiths. Miscell. Coll., vol. 61, No. 15, p. 6 (published reference to the specimen in the British Museum; Christmas I., H. M. S. *Flying Fish;* description); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, May 3, 1929, p. 636 (Flying-fish Cove, Christmas I.).

Diagnostic features.—The cirri are numerous, XXXIV, 14–16 (usually 16), 14 mm. long; the longest cirrus segment is not more than twice as long as broad. The arms are about 90 mm. long; the distal edges of the brachials are rather strongly overlapping. The comb on P_1 is composed of about 25 exceptionally long teeth; P_4 bears a comb of 15–16 teeth, only 9 of its segments not bearing teeth.

Description.—The centrodorsal is moderately large, with a moderately large flat dorsal pole. The cirrus sockets are arranged in 3 closely crowded marginal rows.

The cirri are XXXIV, 14–16 (usually 16), 14 mm. long. The longer proximal segments are nearly twice as long as broad and are slightly constricted centrally. The eighth is a transition segment. The 2 segments preceding the penultimate are from as broad as long to one-third broader than long. The segments distal to the transition segment are very highly polished and bear small dorsal tubercles.

The 10 arms are about 90 mm. long and resemble those of *C. lütkeni.* The distal ends of the brachials are rather strongly overlapping. The elements of the IBr series appear in external view to be united by syzygy.

The distal intersyzygial interval is usually 3 muscular articulations.

P_1 is about 12 mm. long and bears a comb composed of about 25 exceptionally long teeth. P_1 to P_4 are provided with combs. The comb of P_4 consists of 15 or 16 teeth, beyond which extends a toothless tip; only 9 segments of P_4 are not supplied with teeth.

Notes.—In one of the specimens from the Kei Islands the long and slender arms are 100 mm. in length. The centrodorsal is discoidal, with a flat dorsal pole 3.5 mm. in diameter. The cirrus sockets are arranged in 2 and a partial third marginal rows. The cirri are XXXIII, 14–16, 17 mm. long. The sixth is a transition segment. The segments following the transition segment have a very slight pointed subterminal dorsal tubercle. The cirri are rather slender. The comb on P_1 is composed of 29–33 long narrow teeth. P_4 has a comb with 25–26 teeth.

In the other specimen from the Kei Islands the long and slender arms are 110 mm. in length. The cirri are XXIII, 15–16, 15 mm. long.

The specimen from Flying-fish Cove is very small.

Localities.—Christmas Island, south of the Sunda Straits, between Sumatra and Java; H. M. S. *Flying Fish* [A. H. Clark, 1911, 1913] (1, B. M.).

Flying-fish Cove, Christmas Island; C. W. Andrews [A. H. Clark, 1929] (1. B. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 24; 100 meters; hard bottom; April 15, 1922 (2). Pl. 25, figs. 69, 70.

Remarks.—As yet this species is known only from the 4 specimens listed above.

COMISSIA LITTORALIS A. H. Clark

Plate 26, Figures 71, 72

Comissia littoralis A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 18 (description; *Siboga* station 129, reef); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range); p. 21 (detailed description; with pentacrinoid larvae; station 129); p. 273 (listed); pl. 12, figs. 7, 8.

Diagnostic features.—The cirri are XXI–XXII, 16, 10 mm. or 11 mm. long; the longest cirrus segment is scarcely, if any, more than twice as long as the proximal width. The arms are about 60 mm. long, and are slender. The comb of P_1 is composed of 9–11 teeth. P_3 and the following pinnules are without combs.

Description.—The centrodorsal is very thin, discoidal, with the broad bare dorsal pole flat, from 2.5 mm. to 3 mm. in diameter. The cirrus sockets are arranged in a single crowded and more or less irregular row.

The cirri are XXI–XXII, 16, from 10 mm. to 11 mm. long. The first segment is short; the second is about twice as broad as long; the third is about half again as long as the proximal width; the fourth is about twice as long as the proximal width, or slightly longer; the fifth is about as long as the fourth, or slightly shorter. The following segments rapidly decrease in length, becoming after the eighth or ninth slightly broader than long. The fifth and following segments have a slight subterminal dorsal tubercle which gradually moves anteriorly, becoming median after the ninth. The opposing spine is very small, subterminal. The earlier elongate segments are slightly constricted centrally with prominent ends. The distal shorter segments are laterally compressed and therefore appear broad in lateral view.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx. Very narrow subradial clefts are present.

The radials are concealed. The IBr_1 are concealed except in the interradial angles, where their lateral edges diverge at an angle of 90°. The IBr_2 (axillaries) are almost triangular, twice as broad as long, with the lateral edges very short and making an obtuse angle with those of the IBr_1. The division series and arm bases, which are quite without synarthrial or articular tubercles, extend outward at right angles to the dorsoventral axis.

The 10 arms are about 60 mm. long and slender.

P_1 is considerably longer and stouter than the succeeding pinnules and bears a comb which consists of from 9 to 11 teeth. P_3 and the following pinnules are without combs.

Localities.—*Siboga* station 129; anchorage off Kawio and Kamboling Islands, Karkaralong group; reef; July 22–23, 1899 [A. H. Clark, 1912, 1918] (2, with pentacrinoids, U.S.N.M., E. 395; Amsterdam Mus.). Pl. 26, figs. 71, 72.

Dr. Th. Mortensen's Pacific expedition, 1914–1916; Port Galera, Mindoro, Philippines; February 3, 1914 (1).

Remarks.—The pentacrinoids found on the specimens collected by the *Siboga* were described in volume 1, part 2, page 513.

COMISSIA CHADWICKI A. H. Clark

Plate 65, fig. 185

Actinometra parvicirra (part) CHADWICK, in Herdman, Report Ceylon Pearl Oyster Fisheries, pt. 2, suppl. rep. 11, 1904, p. 158 (station XLI); plate, figs. 13, 14.

Comissia, sp. A. H. CLARK, Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (10-armed specimen of *Comanthus parvicirra* figured by Chadwick is a species of *Comissia;* Ceylon, about 100 fathoms; Crinoids of the Indian Ocean, 1912, p. 40 (identification of Chadwick's record); p. 78 (synonymy; description, from Chadwick.)

Comissia chadwicki A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 19 (compared with *C. parvula;* no description); Crinoids of the Indian Ocean, 1912, p. 313 (detailed description of a specimen; identification of Chadwick's record; northeast corner of Ceylon, 28 fathoms); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range).

Diagnostic features.—The cirri are XXIV, 11–14, 10 mm. long; the longest cirrus segments are from two to two and one-half times as long as the proximal width. The rather slender arms are about 60 mm. long. The terminal comb on P_1 has 26–28 teeth.

Description.—The centrodorsal is thin discoidal with a large flat dorsal pole 3.5 mm. in diameter slightly excavated in the center. The cirrus sockets are arranged in a single irregular marginal row.

The cirri are XXIV, 12–14, 10 mm. long. The fourth and fifth segments are the longest, from two to two and one-half times as long as broad proximally. The sixth and following segments bear minute subterminal dorsal spines.

The radials are concealed by the centrodorsal. The IBr series are very widely separated laterally.

The 10 arms are about 60 mm. long and resemble those of *C. hispida*, but are a trifle more slender.

The terminal combs on the lower pinnules appear to have 26 or 28 teeth.

Notes.—The preceding description was drawn up from the specimen from *Investigator* station 175. According to Chadwick's figure the centrodorsal in his specimen is discoidal, broad and flat, with the cirri arranged in a single somewhat irregular marginal row. The cirri are XVIII, 11, with the fourth segment the longest, not quite three times as long as broad. He describes and figures the disk as covered with minute scalelike plates.

Localities.—Ceylon Pearl Oyster Fisheries station XLI; south of Galle, Ceylon, about 12 miles from land; depth, along the 183 meter line; bottom composed of masses of calcareous branched and ramifying foraminiferal tubes; 1902 [Chadwick, 1904; A. H. Clark, 1911, 1912, 1918].

Investigator station 175; off the northeast coast of Ceylon (lat. 8° 51′ 30″ N., long. 81° 11′ 52″ E.); 51 meters; sand, shells, and stones; April 20, 1894 [A. H. Clark, 1912] (1, I. M.). Pl. 65, fig. 185.

Remarks.—Among the specimens recorded under the name of *Actinometra parvicirra* from Ceylon in 1904 by Mr. Herbert C. Chadwick was a 10-armed individual. He noted that in the form and disposition of the elements of the IBr series this differed markedly from the other specimens in the collection and also from those figured by Carpenter. Of this specimen he gave a figure of the dorsal aspect and another of the disk.

I recognized this specimen as in reality representing a species of *Comissia*, and referred it to that genus in 1911.

A similar specimen was found in the *Investigator* collection, and this I described in 1912 under the name of *Comissia chadwicki*.

COMISSIA HISPIDA A. H. Clark

Plate 29, Figure 83

Comissia hispida A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 531 (description; *Albatross* station 5431); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (listed, with habitat); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 19 (compared with *C. parvula*); p. 20 (brachials compared with those of *C. spinosissima*); Crinoids of the Indian Ocean, 1912, p. 77 (synonymy; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 19 (in key; range); p. 20 (description; station 260); p. 275 (listed).

Diagnostic features.—The cirri are XXII, 9–10, 8 mm. long; the longest cirrus segment is about four times as long as broad, and the distal segments are about as long as broad. The arms are probably about 60 mm. long. The IBr_1 are from six to eight times as broad as long, but the axillaries are not greatly broader than long. P_1 is from 12 to 14 mm. long and bears a comb composed of 15–17 long curved teeth which are basally very close together. Combs occur to and including P_6.

Description.—The centrodorsal is thin discoidal with the dorsal pole flat, 3.5 mm. in diameter. The cirrus sockets are arranged in a single fairly regular marginal row.

The cirri are XXII, 9–10, 8 mm. long. The first segment is very short, the second is about twice as broad as long, and the third is the longest, about four times as long as the proximal width, and is a transition segment. The following segment is about twice as long as broad, and the remainder are about as long as broad. The second segment has both ends somewhat expanded. The third has the distal end somewhat expanded, but this feature dies away on the succeeding segments. The segments as far as the third are well rounded in cross section, but those following are laterally flattened, so that they appear considerably broader in lateral view. The fourth and following have small subterminal dorsal tubercles.

The mouth is subcentral and the anal tube submarginal.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal in the median line, but are visible interradially as broad low tubercles. The IBr_1 are exceedingly short, from six to eight times as broad as long. The IBr_2 (axillaries) are triangular, not greatly broader than long, with the anterior angle acute and somewhat produced.

The 10 arms are probably about 60 mm. long, and resemble those of *Comissia lütkeni*. The lower brachials are triangular and about as long as broad. The arms increase slightly in width up to the twelfth or fourteenth brachials, from this point slowly tapering distally.

The distal intersyzygial interval is 3 muscular articulations.

P_1 is from 12 to 14 mm. long, very slender, and composed of 40 segments. The terminal comb is composed of 15–17 long curved teeth which are set very close together basally. P_2 is 12 mm. long and resembles P_1; its comb has 14 teeth. P_3 is 9 mm long and resembles P_2. P_4 is 8 mm. long, with a comb of 14 teeth. P_5 is 7.5 mm. long, with a similar comb. P_6 is somewhat stouter than the preceding pinnules, 5 mm. long, with a rudimentary comb. The following pinnules resemble P_6, but are without combs. The distal pinnules are slender, 9 mm. long.

Notes.—In the specimen collected by the *Siboga* the arms are about 60 mm. long. The dorsal pole of the centrodorsal is 2.5 mm. in diameter. The cirri are XIII, 10–11 (usually 10), 8 mm. long; the longest cirrus segments are very slightly less elongate than in the type specimen, but I can find no other differences.

Localities.—*Albatross* station 5431; in the vicinity of eastern Palawan; Corandagos Island (N. W.) bearing N. 28° E., 4.8 miles distant (lat. 10° 38′ 45″ N., long. 120° 12′ 45″ E.); 93 meters; sand; April 8, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 27485). Pl. 29, fig. 83.

Siboga station 260; 2.3 miles N. 63° W. from the north point of Nuhu Jaan, Kei Islands (lat. 5° 36′ 30″ S., long. 132° 55′ 12″ E.); 90 meters; sand, coral, and shells; December 16, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From Palawan southward to the Kei Islands.

Bathymetrical range.—From 90 to 93 meters.

Remarks.—This species is only known from 2 specimens, one collected by the *Albatross*, the other by the *Siboga*.

COMISSIA SPINOSISSIMA A. H. Clark

Plate 27, Figures 73, 74

Comissia spinosissima A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 20 (description; *Siboga* station 305); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 20 (in key; range); p. 21 (detailed description; station 305); p. 276 (listed); pl. 13, figs. 12, 13.—GISLÉN, Vidensk. Medd. fra Dansk naturh. Foren., vol. 83, 1927, p. 8 (Mortensen's stations 7, 8, 9; notes; *parvula* from Bock's station 8 also this species); figs. 3, 4, p. 15.

Comissia parvula (part) GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 23 (Bock's station 8).

Comissia cf. *spinosissima* GISLÉN, Zool. Bidrag från Uppsala, vol. 9, 1924, fig. 94, p. 87 (synarthrial face).

Comissia, sp. GISLÉN, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 89 (synarthries).

Diagnostic features.—The cirri are XX–XXX, 9–12 (usually 10–11), from 7 to 9 mm. long, small and slender, with the distal edges of the short distal segments rather strongly produced; the longest cirrus segment is about four times as long as the median width; the earlier cirrus segments have much swollen ends. The arms are from 40 to 45 mm. long. The elements of the division series and the brachials have their distal borders armed with very long fine spines. The comb on P_1 consists of 8–10 large teeth. P_4 does not bear a comb.

Description.—The centrodorsal is large, thin discoidal, with the dorsal pole flat, regularly pentagonal, 2 mm. in diameter.

The cirri are XXX, 10–11, 8 mm. long, small and slender, with the distal edges of the short distal segments rather strongly produced. The first segment is very short, the second is twice as long as the expanded ends, and the third is the longest, about four times as long as the median diameter. The fourth is nearly as long as the third, but has the distal end more expanded. The fifth is twice as long as its expanded distal end. The following segments gradually decrease in length so that the antepenultimate is about as long as broad. The second and third segments have both the proximal and distal ends considerably enlarged, slender, and broadly oval in cross section. The fourth has the proximal end only very slightly enlarged, but gradually expanding from the middle to the distal edge, which is produced and overlaps the base of the succeeding segment. The following segments gradually increase in lateral diameter, the enlargement of the distal ends gradually decreasing in extent. The fifth and following segments have slight subterminal tubercles. The opposing spine is terminal, minute, but larger than the tubercle on the preceding segment. The terminal claw is nearly twice as long as the penultimate segment and is strongly curved.

The radials are concealed in the median line, but are slightly visible in the interradial angles. The IBr_1 are very short, oblong, five or six times as broad as long, very closely united with the IBr_2 (axillary), which is triangular, twice as broad as long.

Arms 10, 45 mm. long. The brachials resemble those of *C. hispida*. The ossicles of the division series and brachials have their distal borders armed with very long fine spines.

The segments of the pinnules are exceedingly spinous, the third with a slight, very spinous carination.

Notes.—In the specimen from Dr. Sixten Bock's station 8 the cirri are about XX, 12–13, from 5 to 5.5 mm. long. The second segment is twice as long as broad, the third is three times as long as broad, the fourth is twice as long as broad, and the antepenultimate is a little longer than broad. Some of the apical cirri are very small, only 2 mm. long with 9 segments. In these the antepenultimate segment is half again as long as broad.

The IBr_1 is five times as broad as long. The IBr_2 (axillary) is triangular, twice as broad as long.

The 10 arms are between 15 and 20 mm. in length. The first brachial is three times as broad as long. The second brachial is three times as broad as the outer, and five times as broad as the inner length.

The intersyzygial interval is 3 muscular articulations.

P_1 is 5 mm. long and is composed of about 24 segments, of which 10 bear teeth and take part in the formation of the comb. P_3 is 3.5 mm. long with 17 segments, of which 8 bear teeth. Combs are found only on P_1, P_2, and P_3. P_4 is 3.5 mm. long with 11 segments. The pinnule segments are stout, smooth, and somewhat swollen.

In the specimen from Mortensen's station 7 the centrodorsal is strongly flattened, 2.5 mm. in diameter. The cirri are XXIV, 12–13, from 6 to 7 mm. in length, in an almost single row. The second and third segments are the longest, three and a half times the median width. The fourth segment is three times the median width.

The 10 arms are all broken. The distal edge of the brachials is finely spinous, "besides, here and there, small, not calcified processes giving the arms a slightly fluffy appearance."

P_1 to P_3 are provided with combs. P_1 is 4.5 mm. long with 22–24 segments, 8 of which bear teeth of large size. P_4 is about 3 mm. long, composed of 12 segments, without a comb, and bearing the first gonad. The pinnule segments are expanded at the ends and spiny. The disk is 3 mm. in diameter. The mouth is central.

In the specimen from Mortensen's station 8 the centrodorsal is 1.7 mm. in diameter. The cirri are XXVI, 9–11, about 3 mm. long, arranged in a partly double row. The 10 arms are all broken. The spinosity is rather poorly developed. P_1 bears a comb composed of 8–10 teeth. P_4 is without a comb. The disk is 2.5 mm. in diameter. The mouth is central.

In one of the 3 specimens from Mortensen's station 9 the centrodorsal is 2.5 mm. in diameter. The cirri are about XXV, 10–12, from 5 to 6 mm. in length. The second cirrus segment is from half again to twice as long as the median width. The third is three times as long as broad. The 10 arms are all broken. P_1 to P_3 bear combs. P_4 bears a large gonad. The pinnule bases are slightly notched and spinous. This individual is smoother than that from Mortensen's station 7, but distinctly more spiny than *C. parvula*.

A second specimen from Mortensen's station 9 has the centrodorsal 2.2 mm. in diameter. The cirri are about XX, 11–12, 6 mm. long. The 10 arms are probably about 40 mm. long. P_1 to P_3 bear combs.

The third specimen from Mortensen's station 9 has the cirri about XXII, 12, 7.2 mm. long. P_1 to P_3 bear combs.

Localities.—Dr. Sixten Bock's station 8; off the Goto Islands, Korean Straits; 210 meters; temperature 13.7° C.; April 14, 1914 [Gislén, 1922, 1927].

Dr. Th. Mortensen's station 8; southwest of the Goto Islands (lat. 32° 49′ N., long. 128° 14′ E.); 210 meters; sand; May 14, 1914 [Gislén, 1927].

Dr. Th. Mortensen's station 7; southwest of the Goto Islands (lat. 32° 17′ N., long. 128° 11′ E.); 201 meters; sand; May 14, 1914 [Gislén, 1927].

Dr. Th. Mortensen's station 9; southwest of the Goto Islands (lat. 32° 15′ N., long. 128° 12′ E.); 164 meters; hard bottom; May 15, 1914 [Gislén, 1927].

Siboga station 305; Solor Strait, east of Flores; mid-channel, off Kampong Menanga; 113 meters; stony bottom; February 8, 1900 [A. H. Clark, 1912, 1918] (2, U.S.N.M., E. 411; Amsterdam Mus.). Pl. 27, figs. 73, 74.

Geographical range.—From the Korean Straits southward to the Lesser Sunda Islands.

Bathymetrical range.—From 113 to 210 meters; the average of 5 records is 179 meters.

Thermal range.—One record, 13.7° C.

Remarks.—Gislén says that evidently this species is very closely related to *C. hispida* as well as to *C. parvula*. From the former the specimens which he was able to examine differ by having combs only on P_1 to P_3, *C. hispida* having combs on P_1

to P_6. From *C. parvula* it differs in its more spinous brachials and pinnule segments, somewhat greater slenderness, especially of the cirri, and in having the second cirrus segment usually slightly longer, this feature being particularly distinct in the longest ventral cirri.

History.—This species was originally described from a specimen from the *Siboga* collection in 1912. A more detailed description, with figures, was published in 1918, when a second specimen smaller than the type, but otherwise resembling it, was also recorded.

In 1922 Dr. Torsten Gislén recorded *Comissia parvula* from a number of localities off southwestern Japan, where it had been secured by Dr. Sixten Bock in 1914. In 1924 he referred to one of Bock's specimens as "*Comissia* cf. *spinosissima*," and in 1927 he recorded *C. spinosissima* from 3 of Dr. Th. Mortensen's stations southwest of the Goto Islands, and also mentioned that the specimen from Bock's station 8 originally referred to *C. parvula* should have been referred to this species.

COMISSIA PARVULA A. H. Clark

Plate 28, Figure 77

Comissia parvula A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 19 (description; East Indies; *Siboga*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 20 (in key; range); p. 23 (detailed description; stations 95, 105, 294, 302; no locality; also *Albatross* stations 5162, 5629); pp. 272, 273, 275, 276 (listed); pl. 13, fig. 9.—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (209–728 m.); p. 5 (Sagami Bay); p. 6 (Kiu-Shiu and the Goto Is.; previous records); p. 23 (Bock's stations 4, 8, 36, 37; description of specimens); figs. 12–14, p. 28; Zool. Bidrag från Uppsala, vol. 9, 1924, p. 41 (details of arms).

Diagnostic features.—The cirri are XX–XXIII, 9–13 (usually 11), from 7 to 9 mm. long; the longest cirrus segment is three times as long as broad. The arms are from 45 to 50 mm. (but seldom over 45 mm.) in length. The edges of the elements of the division series are smooth and not produced. The distal edges of the brachials and pinnule segments are not unusually spinous. The comb on P_1 is composed of 9 teeth, which are about as high as the width of the segments bearing them. P_4 does not bear a comb.

Description.—The centrodorsal is large, discoidal, with the dorsal pole flat and from 2 to 2.5 mm. in diameter. The cirrus sockets are arranged in 2 marginal rows.

The cirri are XX–XXIII, 9–13 (usually 11), from 7 to 9 mm. long, resembling those of *C. hispida* but slightly more slender.

The 10 arms are 45 mm. long, and slender.

Notes.—The specimens from *Siboga* station 302 have 9–11 cirrus segments and resemble the following.

The specimens from *Siboga* station 294 have the cirri with 10 segments, 6 mm. long; the arms are 45 mm. long.

In the specimen from the Danish expedition to the Kei Islands station 4 the centrodorsal is discoidal, very thin, the almost flat dorsal pole with a slight very broadly conical elevation in the center. The cirrus sockets are arranged in 3 closely crowded and very irregular marginal rows, of which the innermost, due to the strongly sloping sides of the centrodorsal, seems to be situated on the dorsal surface.

The cirri are numerous, XXXIII, 12–13, rather slender, 10 mm. long. The first segment is twice as broad as long, the second is two and one-half or three times as long as the median width, and the third is a transition segment, five or six times as long as the median width; the following segments rapidly decrease in length so that the 4 or 5 before the penultimate are from one-third to one-half again as long as broad and the penultimate is about as long as broad. The elongate earlier segments have rather strongly concave profiles. The third segment has the dorsal portion of the distal edge slightly produced and armed with very fine spines. This production narrows on the succeeding segments so that the last 3 or 4 before the penultimate have a very slight subterminal dorsal tubercle. The opposing spine is very small, though sharp, median or subterminal. The terminal claw is somewhat longer than the penultimate segment, slender, and less strongly curved distally than proximally.

The ovaries are enormously swollen and contain mature, or nearly mature, eggs. The 3 specimens from station 46 are small.

The example from *Siboga* station 95 has the cirri about XX, 11, 7 mm. long. The dorsal pole of the centrodorsal is 2 mm. in diameter.

The largest individual from *Siboga* station 105 has the cirri XXII, 10–11, 7 mm. long. The dorsal pole of the centrodorsal is 2.5 mm. in diameter. The ovaries contain mature, or almost mature, eggs. The other 4 specimens are very small.

The *Siboga* specimen with the label illegible has the cirri XXIII, 11–13, 9 mm. long. The dorsal pole of the centrodorsal is flat, 2 mm. in diameter. The arms are 45 mm. long. Ripe eggs are present in the ovaries.

The specimen from Bock's station 37 has the centrodorsal discoidal, 2.5 mm. in diameter, the dorsal pole being 1.5 mm. in diameter.

The cirri are arranged in one and a partial second marginal row.

The cirri are XXI, 10–13, from 6.5 mm. to 8 mm. in length. The first segment is broader than long (as shown in Gislén's figure), the second is half again as long as broad, and the third is the longest and most slender, 3 times as long as broad. The fifth and following segments are shorter and somewhat broader in lateral view, half again as long as broad (the figure shows them about as long as broad). From about the fifth segment onward small dorsal tubercles are developed. The antepenultimate segment is about one-fifth again as long as broad. The opposing spine is inconspicuous. The terminal claw is curved, pointed, and somewhat longer than the penultimate segment.

The radials are concealed. The IBr_1 are visible as narrow bands about six times as broad as long. The IBr_2 (axillaries) are low pentagonal or triangular, twice as broad as long.

The 10 arms are from 45 to 50 mm. in length. The first brachials are almost wholly free interiorly. The second brachials are about twice as long exteriorly as interiorly. After the seventh or eighth brachial the articulations become oblique. The width of the brachials in the middle of the arms is about 1 mm. They are about as broad as the greater length. The distal brachials are smooth and not overlapping. There are 15 brachials for each 10 mm. of arm length, or 11 if the syzygial pairs are counted as single units.

Syzygies occur between brachials 3+4, 11+12, 14+15, 18+19, 22+23, and distally at intervals of 2 or 3 muscular articulations.

P_1 is 7 mm. long with about 30 segments, of which 9 or 10 are involved in the formation of the comb and bear teeth which in height are about equal to the width of the segments bearing them. P_2 is 6 mm. long with about 26 segments, of which 9 bear teeth. P_3 is 4.5 mm. long with about 25 segments, 9 of which bear teeth, and a gonad as far as the fourth segment. The combs are confined to P_1, P_2, and P_3. P_5 is 4.2 mm. long with 13 segments, of which the 3 or 4 last bear dorsal processes. The pinnule segments are broad and stout, and the most proximal are notched on the distal side and somewhat widened in the distal part. The distal pinnules are 5.5 mm. long with 17 segments. The lower portion of the pinnules from P_3 to P_{20} is swollen through the ripening of the gonads.

The disk is smooth, 5.5 mm. in diameter. The mouth is central.

The specimen from Bock's station 36 has the centrodorsal 2.5 mm. in diameter, with the bare dorsal pole 1.5 mm. in diameter.

The cirri are XXII, 12, 5 mm. long (only one complete cirrus remaining); they are arranged in a single row on the centrodorsal. The third cirrus segment is the longest, three and one-half times as long as broad. The distal segments are short and laterally compressed. The antepenultimate segment is a little longer than broad.

The radials are visible only as small triangles in the interradial angles. The IBr_1 are very short, eight times as broad as long, basally united. The IBr_2 (axillaries) are low triangular, three times as broad as long. There is a slight synarthrial tubercle on the articulation between the elements of the IBr series.

The 10 arms, all of which are broken, are about 25 mm. long; they are smooth dorsally.

The distal intersyzygial interval is 3 muscular articulations.

P_1 is about 4.5 mm. long with 26 segments, of which 9 bear teeth. P_2 is about 3.5 mm. long with about 22 segments, of which 8 bear teeth. P_3 is similar, 3 mm. long. Combs are confined to P_1, P_2, and P_3. The distal pinnules have 13 segments.

The disk is 3 mm. in diameter.

The specimen from Bock's station 4 resembles that from Bock's station 37. It was found within a calcareous sponge. The cirri are 5.5 mm. long with 12 segments, of which the antepenultimate is as long as broad. The arms are about 30 mm. in length. P_1, P_2, and P_3 bear combs.

Localities.—Siboga station 302; near Rotti, southwest of Timor (lat. 10° 27′ 54″ S., long. 123° 28′ 42″ E.), 216 meters; sand and coral sand; February 2, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 294; south of western Timor (lat. 10° 12′ 12″ S., long. 124° 27′ 18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 4; 250 meters; sand; April 3, 1922 (1); station 46; 250 meters; mud; May 2, 1922 (3).

Albatross station 5629; Patiente Strait, between Halmahera and Batjan, Moluccas; Doworra Island (S.) bearing S. 62° W., 6 miles distant (lat. 0° 50′ 00″ S., long. 128° 12′ 00″ E.); 375 meters; temperature 28.34° C.; coral sand; December 2, 1909 [A. H. Clark, 1918] (1, U.S.N.M., 36019).

Albatross station 5162; Tawi Tawi group, Sulu (Jolo) Archipelago; Tinagta Island (S.) bearing N. 71° W., 5.4 miles distant (lat. 5° 10′ 00″ N., long. 119° 47′

30″ E.); 420 meters; temperature 27.78° C.; coarse sand and broken shells; February 22, 1908 [A. H. Clark, 1918] (1, U.S.N.M., 36003).

Siboga station 95; north of the Tawi Tawi group, Sulu Archipelago (lat. 5° 43′ 30″ N., long. 119° 40′ 00″ E.); 522 meters; stony bottom; June 26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 105; Sulu Archipelago (lat. 6° 08′ 00″ N., long. 121° 19′ 00″ E.); 275 meters; coral bottom; July 4, 1899 [A. H. Clark, 1918] (5, U.S.N.M., E. 410; Amsterdam Mus.).

Siboga; East Indies [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.). Pl. 28, fig. 77.

Dr. Sixten Bock's station 37; off Okinose, Sagami Bay, Japan; 731 meters; July 8, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 36; Sagami Bay, Japan, directly off shore from Misaki; 366 meters; July 1, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 4; the *Metacrinus* shoal off Misaki, Japan; 274 meters; May 5, 1914 [Gislén, 1922].

Erroneous locality.—Dr. Sixten Bock's station 8; Korean Straits, off the Goto Islands; 210 meters; temperature 13.7° C.; May 14, 1914 [Gislén, 1922, 1927]. Gislén redetermined the specimen from this station as *C. spinosissima*.

Geographical range.—From the Lesser Sunda Islands and the Moluccas northward to southern Japan.

Bathymetrical range.—From 73 to 731 meters; the average of 9 records is 358 meters.

Thermal range.—Two records, 27.78° C. and 28.34° C.

Remarks.—This species is closely related to *C. hispida*, but it is a smaller, more delicate, and more slender form. The cirri, while resembling in structure those of *C. hispida*, are usually arranged in 2 rows instead of in a single row on the centrodorsal, and are more slender and more numerous.

From *C. chadwicki*, which also possesses the same type of centrodorsal and of cirrus structure, it differs in having fewer cirrus segments and a smaller centrodorsal, on which the cirri are arranged in two rows instead of in a single irregular row.

History.—This species was originally described in 1912 from specimens secured by the *Siboga*. A more detailed account, with a figure, was published in 1918, when it was recorded from 4 *Siboga* and 2 *Albatross* stations.

Dr. Torsten Gislén recognized it among the specimens collected by Dr. Sixten Bock off southern and southwestern Japan in 1914 and published an account of these in 1922. In 1924 he published some additional notes on the arm structure.

COMISSIA GRACILIPES A. H. Clark

Plate 28, Figures 75, 76

Comissia gracilipes A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 19 (description; *Siboga* station 267); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 20 (in key; range); p. 22 (detailed description; stations 266, 267); p. 275 (listed); pl. 13, figs. 10, 11.—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (728 m.); p. 5 (Sagami Bay); p. 7 (previous records); p. 24 (Bock's station 35; description); figs. 15–17, p. 28.

Diagnostic features.—The cirri are XVIII–XX, 9–12 (usually 9), from 4 to 6 mm. in length; the longest cirrus segment is three times as long as the width of its proximal end, or slightly longer. The arms are from 30 to 40 mm. long and resemble those of *C. parvula.* The comb on P_1 consists of 9–11 long teeth, which are somewhat longer, narrower, and more pointed than the teeth in the combs of *C. parvula.* Combs occur only on P_1 and P_2.

Description.—The centrodorsal is large, discoidal, with a broad flat dorsal pole 2 mm. in diameter. The cirrus sockets are arranged in a single very closely crowded marginal row.

The cirri are lacking in the type specimen; in a smaller specimen from the same locality the cirri are XX, in one and a partial second marginal row, the latter apparently undergoing suppression; there are also traces of the sockets of a third row. The cirri have 9 segments, and are from 4 to 4.5 mm. long. The first segment is nearly or quite twice as broad as long, the second is slightly longer than broad, the third is about three times as long as the diameter of the proximal end, and the fourth slightly longer. The fifth is about as long as the third, the sixth is about twice as long as the diameter of the distal end, and the seventh is slightly shorter. The antepenultimate is half again as long as broad, and the penultimate is about as long as broad. The longer earlier segments are slightly constricted centrally with expanded ends. The dorsal processes on the outer segments are almost obsolete.

Arms 10, from 30 to 35 mm. long, resembling those of *C. parvula.* P_1 is 7 mm. long, bearing a terminal comb consisting of 11 long teeth.

The mouth is central or subcentral, and the anal tube is marginal or submarginal.

Notes.—The type specimen is the larger of the 2 individuals from *Siboga* station 267.

The largest of the 6 examples from *Siboga* station 266 has the arms 40 mm. long; the cirri have been lost.

In one of the 2 specimens from Bock's station 35 the centrodorsal is 2 mm. in diameter, with the bare dorsal pole 1.3 mm. in diameter. The cirri are arranged in a single row.

The cirri are XVIII, 9–12, from 4 to 6 mm. in length. The third segment is three times as long as broad, and the fourth, which is a transition segment, is twice as long as broad. The antepenultimate segment is half again as long as broad.

The radials and the IBr_1 are almost completely concealed by the centrodorsal. The IBr_2 (axillaries) are triangular, three times as broad as long.

The 10 arms are 35 mm. in length. The first brachials are four times as broad as long, interiorly united, very closely articulated with the second brachials which are twice as broad as long exteriorly. The width of the brachials in the middle of the arms is 0.6 mm.; there are 16 brachials for each 10 mm., or 12 if the syzygial pairs are counted as single units. The longer side of the distal brachials is one-third greater than the length.

P_1 is 5 mm. long with 25–27 segments, of which 9–11 bear teeth and are involved in the formation of the terminal comb. P_2 is composed of 23 segments, of which 11 bear teeth. The teeth are somewhat longer, narrower, and more pointed than the teeth in the combs of *C. parvula.* P_3 is 3 mm. long with 16 segments, without a comb.

P_3 and the pinnules succeeding have swollen pinnule bases. The distal pinnules are from 4 mm. to 5 mm. in length and have 13–15 segments, which are twice as long as broad, with expanded articulations.

The disk is 3.5 mm. in diameter.

In the second specimen from Bock's station 35 the centrodorsal is 1.8 mm. in diameter.

The cirri are about XX, 9, 4 mm. long; only a single cirrus remains. The antepenultimate segment is half again as long as broad.

The radials are concealed. The IBr_1 are only visible at the margin of the centrodorsal. The IBr_2 (axillaries) are from three to four times as broad as long, with strongly concave distal sides.

The 10 arms were probably about 15 mm. long. The arms are rather smooth.

The intersyzygial interval is 3 muscular articulations.

P_1 is 4 mm. long with 26 segments of which 9 bear teeth. P_2 is 3 mm. long with about 22 segments, of which 7 or 8 bear teeth. Only P_1 and P_2 bear combs. P_3 is 2.5 mm. long with 10–12 segments.

The disk is 2.5 mm. in diameter.

Localities.—*Siboga* station 266; near the Kei Islands (lat. 5° 56′ 30″ S., long. 132° 47′ 42″ E.); 595 meters; gray mud with coral and stones; December 19, 1899 [A. H. Clark, 1918] (6, U.S.N.M., E. 409; Amsterdam Mus.).

Siboga station 267; near the Kei Islands (lat. 5° 54′ 00″ S., long. 132° 56′ 42″ E.); 984 meters; gray mud with a brown upper layer; December 20, 1899 [A. H. Clark, 1912, 1918] (2, Amsterdam Mus.). Pl. 28, figs. 75, 76.

Dr. Sixten Bock's station 35; off Okinose, Sagami Bay, Japan; 731 meters; June 28, 1914 [Gislén, 1922].

Geographical range.—From the Kei Islands northward to southern Japan.

Bathymetrical range.—From 595 to 984 meters.

Remarks.—After a detailed study of material from southern Japan, Gislén came to the conclusion that although *C. gracilipes* is rather closely related to *C. parvula* it can scarcely turn out to be a young form of the latter. One of his specimens of *C. gracilipes* was mature, with well-developed genital glands, and in this the centrodorsal conceals more of the IBr series than is the case in *C. parvula.*

He noted that the specimens of *C. gracilipes* are of more slender habit than those of *C. parvula* and have more spiny distal pinnules.

History.—This species was originally described in 1912 from a specimen from *Siboga* station 267. It was redescribed and figured, and recorded from station 266 in 1918. In 1922 Dr. Torsten Gislén recorded and described 2 specimens which had been dredged by Dr. Sixten Bock in Sagami Bay, Japan.

COMISSIA HARTMEYERI A. H. Clark

Plate 28, Figures 78, 79; Plate 29, Figures 80–82

Comanthus (*?parvicirra*) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (possibly occurs on the northeast coast of Africa; refers in reality to *Comissia hartmeyeri*).

?Comanthus (*Validia*) *parvicirra* A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, pp. 18, 19 (specimens from the Red Sea possibly this species); vol. 43, 1912, p. 385 (these identified as *Comissia hartmeyeri*).

Comissia hartmeyeri A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 381 (cotype from Eig [Erg] Tor, Gulf of Suez, in U.S.N.M.); p. 385 (identity of previous record); p. 386 (detailed description; locality); Crinoids of the Indian Ocean, 1912, p. 314 (detailed description; Eig [Erg] Tor).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 233 (Erg Tor No. 5601).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 20 (in key; range).

Diagnostic features.—The cirri are usually about X, 12–13, usually about 5 mm. long; the longest cirrus segment is from three and one-half to four times as long as the median width. The arms are slender, from 30 mm. to 39 mm. in length; the brachials, which are relatively long, have strongly produced and overlapping spinous distal ends.

Description.—The centrodorsal is thin discoidal, with the dorsal pole flat, about 1 mm. in diameter.

The cirri are VIII–XIV (usually about X), 10–13 (usually 12 or 13), from 4.5 mm. to 6 mm. (usually about 5 mm.) long. The first segment is short, the second is about as long as broad, the third is from two to three times as long as its median width, and the fourth is the longest, from three and one-half to four times as long as the median width. The fifth segment is not quite so long as the fourth, and the following segments rapidly decrease in length, so that the ninth and following are about as long as broad. The fifth is a transition segment. The longer proximal segments are oval in cross section and are strongly constricted centrally, but the short distal segments have straight sides and are strongly compressed laterally, appearing therefore broad in lateral view. The transition and following segments have the distal dorsal edge everted, forming a minute sharp tubercle in lateral view which is at first subterminal but becomes median on the antepenultimate. The opposing spine is represented by a minute median tubercle which is only slightly larger than the tubercle on the preceding segment. The terminal claw is slightly longer than the penultimate segment, rather stout, and strongly curved, more so basally than distally.

The radials are even with the edge of the centrodorsal in the median line, but extend upward interradially and entirely separate the bases of the IBr_1. The IBr series are widely separated, their sides making nearly a right angle with the sides of the adjacent IBr series. The union of the elements of the IBr series is very close, appearing almost like a syzygy in external view.

The 10 slender arms are from 30 mm. to 39 mm. long. The brachials, which are proportionately long, have strongly produced and overlapping spinous distal ends.

The mouth is marginal and the anal tube subcentral. The anal area is completely covered with small thin calcareous plates.

Notes.—The type material consists of 8 specimens, 3 of which are now in the National Museum.

In the example which was selected as the type specimen the cirri are IX, 11–13, 5 mm. to 6 mm. long. The arms are 30 mm. long. Syzygies occur between brachials 3+4, 10+11, or 11+12 (usually the latter), and 14+15 to 17+18, and distally at intervals of 3, more rarely 2, muscular articulations.

Another specimen has the cirri VIII, 10, 4.5 mm. long. The arms are 33 mm. long.

A third specimen has the cirri XIV, 11–12 (usually the latter), 5 mm. long, and the arms 39 mm. long.

A fourth has the cirri IX, 12–13.

The remaining 4 specimens are similar to these.

Locality.—Erg Tor, Gulf of Suez; Dr. Robert Hartmeyer [A. H. Clark, 1911, 1912, 1918; Hartmeyer, 1916] (8, and pentacrinoids, U.S.N.M., 34946; Berl. M.). Pl. 28, figs. 78, 79; pl. 29, figs. 80–82.

History.—The original specimens of this species I at first (1911) considered as immature individuals, possibly of *Comathus parvicirra;* but in 1912 I described them as representing a new species of *Comissia.*

The pentacrinoids found with them were mentioned in volume 1, part 2, page 514, but not described.

COMISSIA IGNOTA A. H. Clark

Actinometra, sp. nov., Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 510 (Marie Louise I. and Isle des Neufs).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 3 (recorded by Bell from the Amirante Is.); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 79 (of Bell, 1884=*C. ignota*).

Actinometra pectinata (B. M., MS.) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 17; Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 7.

Comanthus (*Validia*) *parvicirra* A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 19 (Seychelles); vol. 43, 1912, p. 385 (specimens from the Seychelles identified as *Comissia ignota*).

Comissia ignota A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast Africa); p. 17 (synonymy; description; localities); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (listed, with habitat); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (identification of the specimens from the Seychelles); p. 386 (Seychelles); Crinoids of the Indian Ocean, 1912, p. 78 (synonymy; locality); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 7 (published reference to specimens in the British Museum; localities; 6-rayed specimen); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 20 (in key; range).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 7 (a variety found at the Bonin Is.).

Diagnostic features.—The cirri are XII–XV, usually 10–11, from 4 to 5 mm. long; the longest cirrus segment is about three times as long as the median width. The arms are slender, from 30 to 35 mm. long, and the brachials have moderately produced and spinous distal edges.

Description.—The centrodorsal is discoidal, with a flat dorsal pole from 1.5 to 2 mm. in diameter.

The cirri are XII–XV, 9–11 (usually 10–11), from 4 to 5 mm. long. The first segment is short, the second is not quite so long as broad, the third is longer, and the fourth is the longest, about three times as long as the median width. The sixth and following are about as long as broad. The third and fourth are strongly constricted centrally. The fifth and following each bear a minute sharp subterminal tubercle. The shorter distal segments are somewhat compressed laterally, and hence appear comparatively broad in lateral view. The opposing spine is slight and inconspicuous.

The radials are concealed by the centrodorsal. The IBr_1 are well separated, the interradial angle of separation being about 90°.

The 10 arms are from 30 to 35 mm. in length, and in general resemble those of *Leptonemaster venustus,* though they are proportionately slightly stouter. The gonads are developed on the pinnules.

Abnormal specimen.—One of the individuals collected by H. M. S. *Alert* at Marie Louise Island is 6-rayed.

Localities.—Alert; Marie Louise Island, Amirante group; 31 meters [Bell, 1884; A. H. Clark, 1911, 1912, 1913, 1918] (9, B. M.).

Alert; Isle des Neufs, Amirante group; 31 meters; coral [Bell, 1884; A. H. Clark, 1911, 1912, 1913, 1918] (1, B. M.).

Seychelles; Professor Brauer [A. H. Clark, 1911, 1912] (1, Berl. M.).

History.—The specimens from the Amirante Islands collected by the *Alert* were recorded by Prof. F. Jeffrey Bell in 1884 simply as *Actinometra*, sp.

In 1910 I found these determined as *Actinometra pectinata*, and in 1911 I described them as a new species under the name of *Comissia ignota*, basing the description on the material from Marie Louise Island.

In an account of the crinoids of Africa published in 1911 I mentioned some "immature comasterids from the Seychelles" which I tentatively regaded as *Comanthus parvicirra*. In 1912, however, they were redetermined as *Comissia ignota.*

COMISSIA MINUTA Gislén

Comissia ignota var. *minuta* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4 (127–209 m.).

Comissia ignota minuta Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 6 (Bonin Is.); p. 25 (Bock's stations 42, 45, 45A, 47, 55, 61; description); figs. 18–20, p. 28; pl. 1, fig. 3.

Diagnostic features.—The cirri are usually XV–XVI, 9–10, not more than 4 mm. long; the longest cirrus segment is about three times as long as broad. The arms are not more than 30 mm. in length.

Characters.—The cirri are XII–XX (usually XV–XVI), 8–12 (usually 9–10).

Gislén remarks that the individuals seem to be mature at an arm length of from 25 to 30 mm., as in such individuals the pinnules are strongly swollen; but even in individuals with shorter arms the gonads are quite visible.

All individuals with complete pinnulation have combs on P_1 and P_2, but none on P_3. The number of teeth in the comb varies from 7 to 10, and is usually 8.

Notes.—In a specimen from Bock's station 45 the centrodorsal is 1.5 mm. in diameter, the bare dorsal pole being 1 mm. across.

The cirri are XV, 10, 3.5 mm. long. The second segment is half again as long as the distal width and is centrally constricted. The third segment is three times as long as broad, the fourth is twice as long as broad, the fifth is three-quarters again as long as broad, and the sixth and seventh are one-third again as long as broad. The antepenultimate is as long as or somewhat longer than broad. The last 3 or 4 segments bear each a small dorsal spine. The terminal claw is somewhat longer than the penultimate segment and is strongly curved.

The radials are visible as small triangles in the interradial angles. The IBr_1 are six times as broad as long, with their lateral edges free and making with those of their neighbors an angle of 45°. The IBr_2 (axillaries) are triangular, twice as broad as long, with very concave distal sides. The 2 elements of the IBr series are united by syzygy.

The 10 arms are about 20 mm. in length. The first 2 brachials are rather narrow, four times as broad as long, and twice as long exteriorly as interiorly. The longer side of the distal brachials is twice their width. There are 20 brachials for each 10 mm., or 15 if the syzygial pairs are counted as units. The width of the brachials is 0.5 mm. The arm bases are fairly smooth.

Syzygies occur between brachials 3+4, 11+12, and 15+16, and distally at intervals of 3 muscular articulations.

P_1 is 4 mm. long with 27 segments. P_2 is 3.5 mm. long with 23 segments. P_1 and P_2 bear combs of 8–10 teeth. P_3 is 2.5 mm. long with 11 segments, without a comb, but with a gonad. The distal pinnules are 4.5 mm. long with 14 segments. The second-fourth pinnule segments are somewhat notched on the outer sides, especially on P_1 and P_2. The bases of the pinnules, however, are smooth, because of enveloping perisome.

The disk is smooth, about 2 mm. in diameter. The mouth is central. There are cushionlike swellings along the ambulacral furrows. The anal cone is broad, stout and short.

In another specimen from Bock's station 45 the cirri are XVI, 10, 3.5 mm. long. The 10 arms are about 30 mm. long. P_1 and P_2 bear combs with 8–10 teeth. P_3 to P_{12} bear gonads.

Another specimen from Bock's station 45 has the cirri XIX, 9–10, from 2.5 mm. to 3 mm. in length. The 10 arms are 15 mm. long. P_2 is very small. The disk is 2 mm. in diameter.

Another specimen from Bock's station 45 has the cirri XVI, 9, 3.5 mm. long. The IBr_1 is five times as broad as long. The 10 arms are 20 mm. long. P_1 and P_2 bear combs, and P_3 to P_9 bear gonads.

In another example from Bock's station 45 the cirri are XIV, 10, 3.5 mm. long. The combs on P_1 and P_2 have 8–10 teeth. The disk is 3 mm. in diameter.

Another specimen from Bock's station 45 has the cirri XVI, 10–12, from 4 to 4.5 mm. in length. P_1 and P_2 bear combs. The disk is 3 mm. in diameter.

Another example from Bock's station 45 has the cirri XVII, 8–9, from 2 to 3 mm. in length. In the smallest cirrus the antepenultimate segment is half again as long as broad. The IBr_1 is turned outward almost at a right angle. The 10 arms are 25 mm. long. P_1 and P_2 bear combs. The disk is 2 mm. in diameter.

Another individual from Bock's station 45 has the cirri XIII, 9–10, from 2 mm. to 3 mm. long. The 10 arms are 25 mm. in length. P_1 is 3.5 mm. long and P_2 is 2 mm. long, both bearing combs. The distal pinnules are 3.5 mm. long with 12 segments.

In another specimen from Bock's station 45 the cirri are XVI, 8–9; the 10 arms are 20 mm. long. P_1 and P_2 bear combs, that on P_1 having 7 teeth.

The last specimen from Bock's station 45 has the cirri XV, 9–10, 3 mm. long. The IBr_1 is four times as broad as long. The IBr_2 (axillary) is half again as broad as long. The 10 arms are about 20 mm. long. P_1 and P_2 bear combs, that on P_1 consisting of 8 teeth. The disk is 2 mm. in diameter.

The specimen from Bock's station 42 has the cirri XVI, 10–12, 4 mm. long. The IBr_1 are almost completely concealed by the centrodorsal. The IBr_2 (axillaries) are twice as broad as long. P_1 is 4 mm. long with 23 segments, of which 8 bear teeth. P_2 bears a comb. The distal pinnules are 3 mm. long with 13 segments. The disk has been thrown off so that the basal star is visible.

In a specimen from Bock's station 47 the centrodorsal is 2 mm. in diameter, the bare dorsal pole being 1.5 mm. across. The cirri are XX, 10–11, 4 mm. long; 4 of the cirri are very small. The IBr_1 are eight times as broad as long. The IBr_2 (axillaries) are five times as broad as long. The 10 arms are 30 mm. long. Syzygies occur usually between brachials 1+2 and 3+4. P_1 is 4 mm. long with 24 segments, of which 9 bear teeth. P_2 is 3.5 mm. long with 20 segments, of which 9 bear teeth. P_3 is 3 mm. long with 11 segments. The distal pinnules are 3.5 mm. long with 14–15 segments. The bases of the pinnules bear swollen gonads. The disk is 3 mm. in diameter. The color is brown.

In another specimen from Bock's station 47 the cirri are XX, 8–9, from 2 mm. to 3 mm. long. The IBr_1 are as in the preceding. The IBr_2 (axillaries) are three times as broad as long. The 10 arms are 27 mm. in length. P_1 and P_2 bear combs. P_3 is 3.5 mm. long with 9 segments. The distal pinnules have 13 segments.

In another example from Bock's station 47 the cirri are XIX, 9–10, from 3 mm. to 4 mm. in length. The IBr_1 are eight times as broad as long. The IBr_2 (axillaries) are three times as broad as long. The 10 arms are 25 mm. long. The first 2 brachials are each four times as broad as long. P_1 is 4 mm. long with about 25 segments, of which 8 bear teeth. P_2 is 3.5 mm. long with 20 segments, of which 7 bear teeth. P_3 is 3 mm. long with 12 segments. The distal pinnules have 12 segments. The gonads are only slightly swollen.

Another specimen from Bock's station 47 has the centrodorsal 1.8 mm. in diameter. The cirri are XIII, 9–10, from 2 mm. to 3 mm. long. The IBr_1 are three times as broad as long. The IBr_2 (axillaries) are twice as broad as long. The comb on P_1 consists of 8 teeth. P_2 bears a comb. The gonads are only slightly swollen.

In another example from Bock's station 47 the centrodorsal is 1.8 mm. in diameter. The cirri are XIV, 9–10, from 2.5 mm. to 3 mm. long. The IBr_1 are three times as broad as long. The IBr_2 (axillaries) are twice as broad as long. The comb on P_1 consists of 8 teeth. P_2 bears a comb. P_3 is 2 mm. long with 10 segments. The gonads are only slightly swollen.

A specimen from Bock's station 55 has the cirri XIX, 10, 3 mm. long. The 10 arms are 25 mm. long. P_1 and P_2 have combs with 8 teeth. The distal pinnules have 12 segments. The gonads are well developed.

Another specimen from Bock's station 55 has the cirri XIX, 9–10, from 3 mm. to 4 mm. long. The IBr_1 are almost completely concealed. The IBr_2 (axillaries) are three times as broad as long. The 10 arms are 30 mm. long. P_1 and P_2 have combs. The gonads are well developed.

Another specimen from Bock's station 55 has the cirri XV, 8–9, 3 mm. long. The IBr_1 are almost completely concealed. The IBr_2 (axillaries) are three times as broad as long. P_1 and P_2 have combs. The gonads are well developed.

Another example from Bock's station 55 has 10 arms 22 mm. long. P_1 and P_2 have combs. The distal pinnules have 10 segments. This specimen is attached to a worm tube.

Another individual from Bock's station 55 has 10 arms 14 mm. long. P_1 and P_2 bear combs. The gonads are somewhat swollen.

Another specimen from Bock's station 55 has the cirri XVI, 8, 2 mm. long. The 10 arms are 18 mm. long. P_1 and P_2 bear combs. The gonads are somewhat swollen.

Another specimen from Bock's station 55 has 10 arms. On some of the arms P_2 is lacking; if present it bears a comb like P_1.

Another individual from Bock's station 55 has the cirri XV, 9, 3 mm. long. The radials are partially visible. The IBr_1 are six times as broad as long. The IBr_2 (axillaries) are three times as broad as long. P_1 and P_2 have combs.

In another specimen from Bock's station 55 the cirri are XVI, 9, from 1.5 mm. to 2.5 mm. long. The third segment is the longest, three and one-half times as long as broad. The antepenultimate segment is one-third again as long as broad. The radials are visible as narrow bands. The IBr_1 are six times as broad as long. The IBr_2 (axillaries) are twice as broad as long. There are 10 arms. P_1 bears a comb. P_2 is absent.

In another specimen from Bock's station 55 the cirri are XIX, 10, 3 mm. long. There are 10 arms. P_1 and P_2 bear combs.

In the last specimen from Bock's station 55 the cirri are XIX, 9, 2.5 mm. long. The antepenultimate segment is one-third again as long as broad. The IBr_1 are six times as broad as long. The IBr_2 (axillaries) are three times as broad as long. The 10 arms are about 15 mm. long. P_1 has a comb with 9 teeth. P_2 is absent from some arms; if present it bears a comb.

In a specimen from Bock's station 61 the cirri are XIII, 10, 3 mm. long. The radials are concealed. The IBr_1 are four times as broad as long. The 10 arms are 15 mm. long. The intersyzygial interval is 3 muscular articulations. P_1 has a comb with 8 teeth. P_2 is inconspicuous or absent. The distal pinnules are 3 mm. long with 12 segments.

The second specimen from Bock's station 61 has the cirri XII, 8–9, from 2 mm. to 2.5 mm. in length. The IBr_1 are twice as broad as long. The IBr_2 (axillaries) are half again as broad as long. The 10 arms are 12 mm. long. P_1 has a comb consisting of 8 teeth. P_2 to P_4 are lacking.

Doctor Gislén remarks that it is interesting to observe the relation between the length and breadth of the most proximal arm ossicles. In the smallest specimens the radials are plainly visible. The IBr_1 are rather long in the smaller specimens, from two to three times as broad as long, but they become shorter during growth, so that, if not almost completely concealed by the centrodorsal, they are from six to eight times as broad as long. The length of the IBr_2 (axillaries) also usually decreases from half again as broad as long to five times as broad as long. This ossicle is never concealed by the centrodorsal.

Localities.—Dr. Sixten Bock's station 42; Bonin Islands; west of Port Lloyd; 128 meters; July 31, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 45; Bonin Islands; east of Chichijima; 146 meters; July 31, 1914 [Gislén, 1922] (1, U.S.N.M., E. 1115).

Dr. Sixten Bock's station 45A; Bonin Islands; east of Chichijima; 164 meters; July 31, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 47; Bonin Islands; east of the channel; 146 meters; August 1, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 55; Bonin Islands; eastnortheast of Chichijima; 210 meters; August 15, 1914 [Gislén, 1922].

Dr. Sixten Bock's station 61; Bonin Islands; eastsoutheast of the channel; 152 meters; August 16, 1914 [Gislén, 1922].

Geographical range.—Only known from the Bonin Islands.

Bathymetrical range.—From 128 to 210 meters; the average of six records is 158 meters.

Remarks.—Doctor Gislén says that these specimens approach *Comissia ignota*, from which they differ in having, on the average, more cirri, by showing certain differences in the proportions of the cirrus segments, in their smaller size, etc.

History.—This species is only known from the 29 specimens collected by Dr. Sixten Bock in 1914 and admirably described by Dr. Torsten Gislén in 1922.

COMISSIA SCITULUS (A. H. Clark)

Comaster (?) scitulus A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 534 (description; *Albatross* station 5356).

Comissia scitulus A. H. Clark, Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (listed, with habitat); Crinoids of the Indian Ocean, 1912, p. 77 (synonymy; range).

Diagnostic features.—The cirri are XIX, 10–12, from 5 mm. to 6 mm. long; the longest cirrus segment is about four times as long as the width of its proximal end, and the penultimate segment is twice as broad as long. The arms are about 60 mm. long. The IBr_1 are about four times as broad as long, and the axillaries are twice as broad as long. The elements of the IBr series and the first 2 brachials have everted and spinous distal ends, and the following brachials have strongly produced and overlapping coarsely spinous distal ends. The terminal comb on P_1 consists of 7–8 small and well-separated teeth, with similar but smaller teeth on the opposite sides of the segments.

Description.—The centrodorsal is thin discoidal, with the dorsal pole flat, 1.5 mm. in diameter.

The cirri are XIX, 10-12, from 5 mm. to 6 mm. long. The first segment is short, the second is somewhat longer than the width of its expanded ends, the third is from two to two and one-half times as long as the width of its expanded ends, and the fourth, which is a transition segment, is the longest, about four times as long as the width of its expanded proximal end. The following segments become very rapidly shorter, and at the same time become laterally compressed and therefore broader in lateral view. The penultimate segment is twice as broad as long. The fourth and following segments have the distal edge thickened on the dorsal side, and small sharp subterminal dorsal tubercles which become median on the antepenultimate. The opposing spine is prominent, but small, terminal, erect or nearly erect, in height equal to about one-third the lateral width of the penultimate segment. The second and third segments have considerably expanded ends. The fourth segment has the distal end much expanded, this feature gradually dying away distally. The terminal claw is nearly twice as long as the penultimate segment and is rather slender and moderately curved.

The radials are concealed by the centrodorsal. The IBr_1 are very short, oblong, about four times as broad as long, in apposition laterally. The IBr_2 (axillaries) are nearly triangular, twice as broad as long, with a shallow groove on the dorsal side at the anterior angle, as in *Comatula pectinata*.

The 10 arms are about 60 mm. long. The first brachials are wedge-shaped, about three times as broad as the exterior length, basally united interiorly. The second brachials are more obliquely wedge-shaped, about twice as broad as the exterior length. The first syzygial pair (composed of brachials 3+4) is nearly twice as broad as long. The next 2 brachials are nearly oblong, about twice as broad as long, and the following become very obliquely wedge-shaped, almost triangular and nearly as long as broad, and further out less obliquely wedge-shaped and longer than broad terminally. The elements of the IBr series and the first 2 brachials have everted and spinous distal ends, and the following brachials have strongly produced and overlapping coarsely spinous distal ends.

Syzygies occur between brachials 3+4, again from between brachials 10+11 to between brachials 13+14 (usually in the latter position), and distally at intervals of 3 muscular articulations.

P_1 is 7 mm. long and is composed of about 25 segments, all of which are about as long as broad. Their dorsal surface is excessively spiny, and frills of long spines fringe their distal edges. The terminal comb consists of 7 or 8 small and well-separated teeth, with similar but smaller teeth on the inner side of the pinnule. P_2 is 4 mm. long with 16–20 segments, similar to P_1. P_3 is somewhat larger, 5 mm. long, with 18–20 segments, the third-seventh or -eighth with a gonad, and a terminal comb. P_4 and the following pinnules are 4 mm. long, somewhat stouter than P_3, and without terminal combs, composed of about 12 very spiny segments. The distal pinnules are very slender, about 5 mm. long.

Locality.—*Albatross* station 5356; north Balabac Strait; Balabac Light bearings S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long. 117° 18′ 45″ E.); 106 meters; temperature 27.78° C.; sand and shells; January 5, 1909 [A. H. Clark, 1911, 1918] (1, U.S.N.M., 27488).

Remarks.—This species is as yet only known from the original specimen from which it was described.

Genus LEPTONEMASTER A. H. Clark

Actinometra (part) von Graff, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, pp. 130, 131, and following authors.

Leptonemaster A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 498 (type *L. venustus*, sp. nov.); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Capillasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 151 (comparison with *Cominia*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represents in the West Indies the East Indian *Comissia*); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (together with *Comatilia* represents *Comissia* in the West Indies); American Journ. Sci., ser. 4, vol. 32, 1911, No. 188, p. 129 (characteristic of the West Indian fauna; significance); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to *Comissia*, part); Internat. Revue der gesamt. Hydrobiol. u. Hydrog., 1914, pp. 3, *et seq.* (in the Atlantic represents *Comissia*, in part; range); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, p. 309 (Caribbean; corresponds to the East Indian *Comissia;* connects the Caribbean Sea with the southwestern Indian Ocean); Die Crinoiden der Antarktis, 1915, p. 181 (range; represented in the Indo-Pacific by *Comissia*, part); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 3 (in key); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies); p. 15 (in key); the Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range); p. 50 (in key).

Diagnosis.—A genus of Capillasterinae including species in which the arms are 10 in number; all the pinnules are present; the first and second segments of the proximal pinnules bear a very high and broad carinate process, of which the crest, at least on the second segment, is parallel with the longitudinal axis of the pinnule; the terminal combs on the proximal pinnules consist of 13–15 teeth, which are only slightly higher than the width of the segments bearing them and are confined to the distal half of the pinnule; none of the segments of the proximal pinnules are more than very slightly longer than broad; there is no modification of the dorsal surface of the lower brachials; the cirri are slender, but not excessively so, with the last 2 segments little or not at all longer than broad; and the arms more than 20 mm. in length.

Geographical range.—Throughout the Caribbean Sea and Gulf of Mexico.

Thermal range.—From 8.33° C. to 24.72° C.

Remarks.—This is a rather well marked genus of somewhat uncertain affinities. It is possibly most closely related to *Comanthoides* of southeastern Australia, which also has the basal segments of the proximal pinnules crested.

LEPTONEMASTER VENUSTUS A. H. Clark

Plate 22, Figures 59–61

[See also vol. 1, pt. 1, fig. 57 (comb), p. 83; fig. 234 (ventral view of centrodorsal), p. 247; fig. 325 (cirrus), p. 279; fig. 452 (dorsal view of radial pentagon), p. 353; part 2, figs. 11, 12 (centrodorsal and radials), p. 6; fig. 236 (arm), p. 197; figs. 389, 390 (pinnule tip), p. 245; fig. 686 (disk), p. 341; fig. 783 (adambulacral deposits), p. 366]

Actinometra meridionalis var. *carinata* (P. H. Carpenter, MS.) von Graff, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, pp. 130, 131 (*nomen nudum;* off Grenada, 262 fathoms; myzostomes); *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 19, 51, 52, 53, 68 (*Blake* stations 249, 203; myzostomes).—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, pp. 186, 210 (myzostomes; after von Graff).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 421 (*Blake* stations 249, 203; myzostomes).—Boulenger, British Antarctic (*Terra Nova*) Exped., 1910, Nat. Hist. Report, Zoology, vol. 2, No. 6, Jan. 22, 1916, p. 136 (host of *Myzostomum cysticolum*).

Leptonemaster venustus A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 499 (*Grampus* station 5104; description); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 17 (arms compared with those of *Comissia ignota*, sp. nov.); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 7 (Cuba); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 8 (obtained by the Barbados-Antigua expedition); pp. 10, 11 (occurrence at Barbados); p. 24 (stations, 3, 7, 11, 13, 18, 46, 56, 59, 67, 78); p. 27 (listed); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 15 (terminal comb); pl. 2, fig. 19 (ambulacral deposits); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 39, footnote (disk reaches to brachial 5).

Actinometra echinoptera var. *carinata* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Blake* stations 127, 155, 177, 178); p. 417 (stations 203, 246, 249, 298, 10–1880; 18° 13′ 20″ N., 78° 36′ 40″ W., 103 fathoms; ?loc.); p. 418 (Santa Cruz; Dominica; Martinique; Grenada; 18° 13′ 20″ N., 78° 36′ 40″ W.; ?38, 88–262 fathoms); pp. 433–435 (detailed description and comparisons); pl. 16, figs. 6, 14; pl. 17, figs. 1, 2, 11, 12.

Actinometra echinoptera var. *carinata-pulchella* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Blake* station 155); p. 418 (Montserrat, 88 fathoms); p. 435 (in text).

Actinometra echinoptera var. *carinata-discoidea* Hartlaub, Mem. Mus. Comp. Zoöl., vol 27, No. 4, 1912, p. 417 (*Blake* station ?246); p. 418 (Grenada, 154 fathoms); p. 469 (Grenada, 154 fathoms [or Martinique, 96 fathoms]; description); pl. 17, figs. 8, 16, 17, 19.

Actinometra echinoptera var. *meridionalis* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 426 (Barbados); pl. 16, fig. 1.

Actinometra echinoptera var. *meridionalis-carinata* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 435 (*Blake* station 156).

Comactinia echinoptera (part) H. L. Clark, Univ. of Iowa Monographs; Bull. Lab. Nat. Hist., vol. 7, No. 5, first ser., No. 15, April 1918, p. 8 (station 7).

Diagnostic features.—There are never more than 10 arms; the cirri are rather long and slender with 12–15 (usually 13–14) segments, of which the fourth is from two and one-half to three times as long as its proximal width and the following decrease in length so that the penultimate is about as long, or not quite so long, as broad; the fifth and following have a small, though prominent, sharp subterminal dorsal spine; the first 2 segments of P_2 and P_3 are produced dorsally into high and conspicuous carinate processes. The animal is rather slender; the arms are from 70 mm. to 90 mm. long, and the cirri are 10 mm. long.

An examination of the cirri and of the bases of P_2 and P_3 will distinguish this species at once from *Comactinia meridionalis*, which it resembles in size and in the number of arms.

Description.—The centrodorsal is a thin flat disk. The small cirrus sockets are arranged in a single crowded marginal row, usually 5 to each radial division.

The cirri are XV–XX, 12–15 (most commonly 13 or 14), 10 mm. long. The first segment is short, the second is half again as broad as long to nearly square in lateral view, the third is about twice as long as its terminal diameter, the fourth is the longest, two and one-half to three times as long as its proximal diameter, and the fifth is a transition segment, not quite so long as the fourth, with a dark band about its center. The following segments gradually decrease in length, the antepenultimate being very slightly longer than broad, or squarish, and the penultimate squarish or not quite so long as broad. The second to sixth segments are slender, moderately constricted centrally with prominent articulations, the following becoming rather strongly compressed laterally (the outer portion of the cirri therefore becoming broader in lateral view) and progressively less and less constricted centrally. The transition and following segments have a small, though prominent, sharp subterminal dorsal spine. The opposing spine is slightly marked, median in position, arising from the entire dorsal surface of the penultimate segment. The terminal claw is somewhat longer than the penultimate segment (about as long as the antepenultimate), moderately stout and moderately curved, the curvature being strongest in the basal portion.

The ends of the basal rays are visible as rather prominent tubercles in the angles of the calyx.

The radials are entirely concealed, or just visible over the ends of the basal rays; they are separated distally. The IBr_1 are short, nearly four times as broad as long, the proximal edge convex, not in contact basally, rounded and widely free laterally, the sides of adjacent IBr_1 making with each other an angle of about 90°. The IBr_2 (axillaries) are triangular, the anterior angle somewhat produced, about one and one-half times as broad as long, the very short lateral edges making an obtuse angle with those of the IBr_1.

Arms 10, from 70 mm. to 90 mm. long. The first brachial is short, slightly wedge-shaped, about three times as broad as the exterior length, entirely separated from its fellow by the anterior apex of the IBr_2, the interior edges of the two diverging at an angle of approximately 90°, or slightly less. The second brachial is irregularly quadrate, slightly larger than the first. The first syzygial pair (third and fourth brachials) is oblong, about half again as broad as long. The next 3 brachials are approximately oblong, about twice as broad as long, the following becoming obliquely wedge-shaped and after the tenth triangular, about as long as broad, farther out on the arm very obliquely wedge-shaped, about as long as broad, and in the terminal portion longer than broad. After about the sixth the brachials develop strongly produced and overlapping distal ends.

Syzygies occur between brachials 3+4, again between brachials 10+11 to 12+13, and distally at intervals of 3 muscular articulations.

P_1 is 10 mm. long, moderately stout basally and evenly tapering, composed of about 35 segments. The terminal comb has 13 to 15 teeth, preceded by 2 or 3 more or less rudimentary. The teeth are spade-shaped or triangular, higher than broad, slightly higher than the height of the segments which bear them, well separated, and incurved. The basal segments of the pinnule are broader than long, the proportionate length gradually increasing so that the segments from the middle onward are approximately squarish. The segments have prominent dorsal projections, with the apex at the distal end, and strongly produced distal edges, these characters dying gradually away after about the middle of the pinnule. P_2 is much more slender than P_1, 7 mm. long, with the segments after the fifth squarish. The first two segments have strong dorsal processes or broad carinations, that of the second the stronger. The following segments have rounded dorsal processes and prominent distal edges. The terminal comb is rather long, with 16 fully developed and 5 or 6 smaller and more rounded teeth. The teeth are proportionately slightly longer and better developed than the teeth of P_1. P_3 is about 4 mm. long, slender and delicate, with the first 2 segments disproportionately large, about half again as broad as long, the second with a much produced distal dorsal angle or even distal half of the dorsal side; the third segment is squarish, and the following segments are slightly longer than broad. The third and following segments as far as the comb, as in P_2, have strongly produced and coarsely spinous distal ends. The comb is as in P_2. P_4 is 3.5 mm. long, slightly more delicate than P_3, with no enlargement of the 2 basal segments, and no comb. The first two segments are short, the third is longer than broad, and the following increase slightly in length, being about half again as long as broad distally. The third and following segments have produced and coarsely spinous distal edges. P_5 is similar to P_4, 4 mm. long with 16 segments, but slightly stouter. The following pinnules are similar to P_5, increasing very gradually in length. The distal pinnules are 8 mm. to 9 mm. long, slender, with about 21 segments, the first 2 not so long as broad, the third slightly longer than broad, the following becoming elongated and about three or four times as long as broad distally. The third and following segments have expanded articulations and coarsely spinous distal ends.

In the lateral perisome of the pinnules are slender, very delicate, and more or less irregular, sometimes branched, rods, evenly spaced, lying at right angles to the border of the pinnulars, sometimes in groups of 2 or 3, about 3 (or 3 groups) to a pinnular; occasionally these become more numerous, forming a very loose and rudimentary narrow crescentic meshwork about the distal border of the marginal lappets.

The spicules in the tentacles are unusually abundant, and often form along the distal side a continuous meshwork reaching nearly to the tip.

The disk is naked; the mouth and anal tube are about equally excentric.

Notes.—Hartlaub described his *Actinometra echinoptera* var. *carinata* especially on the basis of specimens from Grenada.

The centrodorsal is discoidal, sometimes sharply pentagonal, of varying size, and usually with the dorsal surface slightly convex. The cirrus sockets are arranged in a partially double marginal row.

The cirri are up to XXV, 14–15, very slender and strongly compressed distally. The third–fifth segments are greatly elongated and are centrally constricted. From the seventh onward the segments are uniformly short and have a weak dorsal keel which distally rises into a small terminal dorsal spine.

The radials are concealed. The IBr_1 are short and laterally free. The IBr_2 (axillaries) are almost or quite triangular, with a slight proximal convexity of the lower border and a somewhat depressed surface.

The 10 arms are very slender, from 60 to 75 mm. in length. Their surface is not smooth. The brachials are moderately long. The first brachials are short and are closely united interiorly. The second brachials are somewhat longer and are free interiorly. The first syzygial pair (composed of brachials 3+4) is still longer. The fifth and sixth brachials are somewhat shorter again. All of these brachials, like those following, have somewhat everted ends. The seventh and eighth brachials are wedge-shaped, intermediate between the preceding and the following triangular brachials. These triangular moderately long brachials have everted ends, but do not overlap the brachials succeeding. The syzygial pairs are remarkable for their unusual length. Toward the ends of the arms the brachials become elongated and bluntly wedge-shaped.

Syzygies occur between brachials 3+4, again from between brachials 12+13 to between brachials 14+15 (often between brachials 13+14 or 14+15), and distally usually at intervals of 3 or 4 musuclar articulations.

The pinnules are all slender and flagellate. The comb on the proximal pinnules is well developed, and sometimes occurs on P_4. On P_1 the comb involves 14–16 segments. P_2 is somewhat shorter and more slender than P_1, and P_3 is somewhat shorter and more slender than P_2. P_4 is the smallest pinnule. The pinnules succeeding P_4 gradually increase in length. The proximal pinnules from P_1 to P_3 on the lower half of the distal edge are strongly toothed, as a result of the individual segments being here produced and these productions being beset with small spines. This condition does not occur beyond P_3. On P_1 and P_2, and to a greater or lesser extent on P_3, the 2 basal segments contrast strongly with those following through their superior size and breadth. In most of the specimens these 2 segments are conspicuously keeled. The segments of the distal pinnules are, with the exception of the basal, elongated and somewhat constricted centrally.

The disk is 7 mm. in diameter. The mouth is interradial and lies rather centrally. Scattered over the disk are calcareous concretions, which are especially numerous in the anal area.

According to Hartlaub the color in alcohol is usually pure white, more rarely (*Blake* station 246) brownish white, sometimes (*Blake* station 203) with 2 dark longitudinal lines on the arms.

Hartlaub remarked that the very youngest specimens are determinable by the form of the cirrus segments and the well-developed comb on P_1, while, as is shown by a very small specimen from *Blake* station 127, the carination of the basal segments of the pinnules is less diagnostic. This very young individual has long brachials which are strongly constricted centrally.

Two others, without locality, which are just as young, have the carination of the basal segments developed on P_1, or even on P_1 and P_2. Another young individual, also without locality, is remarkable in having the brachials with a granulated surface, an ornamentation which was not observed by Hartlaub in any other West Indian comasterid.

Hartlaub says that intermediates occur between *carinata* and most of the other varieties of *Actinometra echinoptera*, with the exception of var. *valida* (*Comactinia echinoptera*) and var. *alata* (*Neocomatella alata*). Some of these he described under the name of var. *meridionalis-carinata*, which includes specimens of both *Comactinia echinoptera* and *Leptonemaster venustus*.

He considered *Actinometra echinoptera* var. *carinata* as especially close to *Actinometra echinoptera* var. *rubiginosa* (*Nemaster rubiginosa*).

A specimen from *Blake* station 156 with strongly keeled lower pinnules, according to Hartlaub, shows the yellowish speckling of the arms, especially on the syzygial pairs, which is present in *Actinometra echinoptera* var. *pulchella* (*Neocomatella pulchella*).

Significant also, according to Hartlaub, are those intermediates between this form and *Actinometra echinoptera* var. *discoidea* (*Nemaster discoidea*). They show the remarkable features of the pinnule segments of *discoidea*, without, however, possessing the interradial plating of the disk which especially distinguishes the varieties *discoidea* (*Nemaster discoidea*) and *lineata* (*Nemaster rubiginosa*).

One of the specimens from *Blake* station 32 carries several large stalked barnacles of the genus *Scalpellum* on the cirri.

The specimen in the Museum of Comparative Zoölogy from the University of Iowa's Bahamas Expedition station 7, determined by Dr. H. L. Clark as *Comactinia echinoptera*, is in reality this species; it has the arms about 70 mm. long.

Eight specimens from *Blake* station 155 have the arms up to 60 mm. in length.

Hartlaub noted that the specimens from *Blake* station 203 have especially rough arms and pinnules, as a result of sharper and more spinous distal edges to the brachials and a development of small spines on the edges of the pinnule segments. In one of these specimens the mouth, which is interradial, is almost central.

One of the specimens recorded by Hartlaub as *Actinometra echinoptera* var. *meridionalis* from Barbados is in reality this species, as is shown by his figure. He mentions this specimen as typical of those showing an approach, through an especially slender form and somewhat elongated brachials with smooth arm bases, to var. *carinata*.

The 20 specimens from the University of Iowa's Barbados-Antigua expedition station 11 have the arms from 20 mm. to 50 mm. in length.

The specimens from the University of Iowa's Barbados-Antigua expedition stations 3, 7, 13, and 78 are all small.

The specimen from the University of Iowa's Barbados-Antigua expedition station 46 has the arms about 65 mm. long; that from station 56 has the arms about 30 mm. long; that from station 59 has the arms 50 mm. long; the 5 from station 67 have the arms up to 65 mm. in length.

Abnormal specimen.—One of the examples from *Grampus* station 5104 (U.S.N.M., 34635) has only 9 arms, one of the IBr series being absent.

Localities.—*Blake* station 32; northern part of the Yucatan Bank (lat. 23° 32′ 00″ N., long. 88° 05′ 00″ W.); 174 meters; 1877 (2, M. C. Z., 227).

Grampus station 5118; western coast of Florida (lat. 26° 30′ 00″ N., long. 83° 55′ 00″ W.); 108 meters; temperature 20.56° C.; hard bottom; March 23, 1889 (1, U.S.N.M., 34650).

Grampus station 5104; western coast of Florida (lat. 26° 13′ 00″ N., long. 83° 44′ 00″ W.); 93 meters; temperature 20.56° C.; white sand; March 18, 1889 (60 U.S.N.M., 25457, 33107, 34619, 34635, 34645, 35717, 36247, 36254). Pl. 22, figs. 59–61.

Blake station 45; northwest of the Dry Tortugas (lat. 25° 33′ 00″ N., long. 84° 21′ 00″ W.); 185 meters; temperature 16.50° C.; 1878 (2, M. C. Z., 448).

Albatross station 2166; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 20′ 30″ W.); 358 meters; temperature 22.17° C.; May 1, 1884 (1, U.S.N.M., 34646).

Albatross station 2159; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 08″ W.); 179 meters; April 30, 1884 (4, U.S.N.M., 16899, 34874).

Albatross station 2330; off Habana, Cuba (lat. 23° 10′ 48″ N., long. 82° 19′ 15″ W.); 221 meters; January 17, 1885 (1, U.S.N.M., 36291).

Albatross station 2323; off Habana, Cuba (lat. 23° 10′ 51″ N., long. 82° 19′ 03″ W.); 298 meters; January 17, 1885 (1, U. S. N. M., 34617).

Albatross station 2333; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 19′ 12″ W.); 309 meters; January 19, 1885 (2, U.S.N.M., 34942).

Albatross station 2336; off Habana, Cuba (lat. 23° 10′ 48″ N., long. 82° 18′ 52″ W.); 287 meters; January 19, 1885 (7, U.S.N.M., 34602).

Albatross station 2320; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 18′ 48″ W.); 238 meters; January 17, 1885 (1, U.S.N.M., 34616).

Albatross station 2334; off Habana, Cuba (lat. 23° 10′ 42″ N., long. 82° 18′ 24″ W.); 122 meters; January 19, 1885 (3, U.S.N.M., 34615).

Albatross station 2327; off Habana, Cuba (lat. 23° 11′ 45″ N., long. 82° 17′ 54″ W.); 333 meters; January 17, 1885 (1, U. S. N. M., 34613).

Albatross stations 2319–2350; off Habana, Cuba; 60–510 meters; January 17–20, 1885 (1, U.S.N.M., 36094).

Albatross; off Habana, Cuba; 1885 (1, U.S.N.M., 16911).

University of Iowa's Bahamas expedition station 7; off Habana, Cuba; 256 meters (1, M. C. Z., 744).

Cuba [A. H. Clark, 1913] (2, B. M.).

Blake station X; western coast of Jamaica (lat. 18° 13′ 20″ N., long. 78° 36′ 40″ W.); 188 meters; 1880 (1, M. C. Z., 408).

Fish Hawk station 6088 (original No. 160); off Vieques; Sail Rock bearing NE. ¼ N., 10.75 miles distant; 42 meters; coral; February 8, 1899 (fragments, U.S.N.M., 36279).

Blake station 127; off Santa Cruz (lat. 17° 46′ 10″ N., long. 64° 53′ 15″ W.); 70 meters; temperature 24.72° C.; January 4, 1879 [Hartlaub, 1912] (1, M. C. Z., 418).

Blake station 132; off Frederickstadt, Santa Cruz (lat. 15° 37′ 55″ N., long. 64° 54′ 20″ W.); 214 meters; temperature 18.33° C.; rock and broken shells; January 5, 1879 (1, M. C. Z., 212).

Blake station 155; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [Hartlaub, 1912] (17, M. C. Z., 215, 407, 419, 428).

Blake station 156; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [Hartlaub, 1912].

Blake station 178; off Dominica (lat. 15° 34′ 10″ N., long. 61° 29′ 35″ W.); 238 meters; temperature 16.39° C.; yellow sand; January 25, 1879 [Hartlaub, 1912] (1, M. C. Z., 424).

Blake station 177; off Dominica (lat. 15° 32′ 18″ N., long. 61° 30′ 10″ W.); 216 meters; temperature 18.33° C.; sand and broken shells; January 24, 1879 [Hartlaub, 1912] (5, M. C. Z., 423).

Blake station 203; off Martinique (lat. 14° 28′ 50″ N., long. 61° 05′ 40″ W.); 175 meters; temperature 16.11° C.; sand and broken shells; February 10, 1879 [von Graff, 1884; Hartlaub, 1912] (12, M. C. Z., 219, 221, 420).

Blake station 285; off Barbados (lat. 13° 05′ 12″ N., long. 59° 37′ 18″ W.); 24 meters; coral; March 7, 1879 (1, M. C. Z., 450).

Blake station 272; off Barbados (lat. 13° 04′ 12″ N., long. 59° 36′ 45″ W.); 139 meters; temperature 18.17° C.; coral and broken shells; March 5, 1879 (1, M. C. Z., 214).

Blake station 298; off Barbados (lat. 13° 03′ 28″ N., long. 59° 37′ 40″ W.); 219 meters; temperature 16.11° C.; rock; March 10, 1879 [Hartlaub, 1912] (1, M. C. Z., 425).

University of Iowa's Barbados-Antigua expedition station 3; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 7; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 11; Barbados [A. H. Clark, 1921] (20, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 13; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 18; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 46; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 56; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 59; Barbados [A. H. Clark, 1921] (1, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 67; Barbados [A. H. Clark, 1921] (5, U. I. M.).

University of Iowa's Barbados-Antigua expedition station 78; Barbados [A. H. Clark, 1921] (1, U. I. M.).

Blake; Grenada or Martinique (3, M. C. Z., 427).

Blake station 246; off Grenada (lat. 12° 05′ 45″ N., long. 61° 45′ 40″ W.); 281 meters; temperature 13.33° C.; dark gray ooze; February 25, 1879 [Hartlaub, 1912] (2, M. C. Z., 421).

Blake station 249; off Grenada (lat. 11° 48′ 15″ N., long. 61° 48′ 45″ W.); 479 meters; temperature 8.33° C.; coarse sand; February 27, 1879 [von Graff, 1883, 1884; Hartlaub, 1912] (21, M. C. Z., 217, 220, 223, 422).

Blake; label lost (13, M. C. Z., 426).

No label; presumably *Blake* (1, M. C. Z., 444).

Albatross station 2142; eastern part of the Gulf of Darien, Colombia (lat. 9° 30′ 15″ N., long. 76° 20′ 30″ W.); 77 meters; March 23, 1884 (1, U.S.N.M., 34823).

Geographical range.—Throughout the Caribbean Sea and Gulf of Mexico.

Bathymetrical range.—From 24 to 479 (?510) meters; the average of 30 records is 214 meters. This species is, however, common in shallower water than is indicated by the records.

Thermal range.—From 8.33° C. to 24.72° C.; the average of 15 records is 18.05° C. This species is common in water which is warmer than the records would indicate.

History.—This species was first mentioned in 1883 by Prof. Ludwig von Graff in his account of the myzostomes in the *Blake* collection. He referred to it as *Actinometra meridionalis* var. *carinata*, the name having been furnished him by Dr. P. H. Carpenter, and recorded it from *Blake* station 249. In the following year in his account of the myzostomes collected by the *Challenger* he again mentioned it and recorded it from *Blake* stations 249 and 203.

Finding in the collection of the United States National Museum a number of specimens of a small 10-armed species evidently allied to the species of *Nemaster* and *Neocomatella*, it never occurred to me that they could represent what Carpenter had designated as variety *carinata* of *Comactinia meridionalis*, a wholly different type belonging to a widely different group, and I accordingly in 1909 described them under the name of *Leptonemaster venustus*.

On the appearance of Hartlaub's monograph on the *Blake* comatulids in 1912 I at once recognized in his *Actinometra echinoptera* var. *carinata* my *Leptonemaster venustus*. Other specimens of the same species were also described under the names *Actinometra echinoptera* var. *carinata-pulchella*, *Actinometra echinoptera* var. *carinata-discoidea*, *Actinometra echinoptera* var. *meridionalis*, and *Actinometra echinoptera* var. *meridionalis-carinata*.

In 1913 I recorded some specimens from Cuba which I had studied at the British Museum in 1910.

Among the specimens from the University of Iowa's Bahamas expedition which were recorded by Dr. Hubert Lyman Clark in 1918 under the name of *Comactinia echinoptera* I found an example of this form from station 7.

In 1921 I recorded this species from a number of different stations about Barbados, and in 1923 I gave its range as worked out from my unpublished notes.

Genus COMATILIA A. H. Clark

Comatilia A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (diagnosis; type *C. iridometriformis*, sp. nov.); p. 497 (original reference, genotype, and range); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Capillasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 132 (side plates only); p. 151 (comparison with *Cominia*); Proc. U. S. Nat. Mus., vol. 38, 1910, p. 331, footnote (has 5 interradials when young); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (with *Leptonemaster* represents *Comissia* in the West Indies); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 654 (central mouth); American Journ. Sci., ser. 4, vol. 32, 1911, p. 129 (characteristic of the West Indian fauna; significance); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Comissia*, part); Internat. Revue der gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 3 et seq. (represents *Comissia*, in part, in the Atlantic; range and its significance); Die Crinoiden der Antarktis, 1915, p. 132 (covering plates); p. 181 (range; representative in the Atlantic of the Indo-Pacific *Comissia*, part); American Naturalist, vol. 49, 1915, p. 525 (asymmetry absent); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4 (in key).—Bather, Ann. and Mag. Nat. Hist., ser. 9, vol. 1, No. 4, April, 1918, p. 298 (interradials).—A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies); p. 15 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range); p. 50 (in key).

Diagnosis.—A genus of Capillasterinae including small species with 10 arms only and a central mouth; the second, third, and fourth pairs of pinnules are absent, so that there are no pinnules between P_1 and P_5 on the outer and P_a and P_e on the inner side of the arms.

Geographical range.—Only known from east of Brunswick, Ga.

Bathymetrical range.—Only known from 512 meters.

Thermal range.—One record, 6.95° C.

Remarks.—This is the only genus of Comasteridae with deficient pinnulation, with large and well-formd covering plates along the pinnule ambulacra, and with perisomic interradials.

In the Oligophreata deficient pinnulation occurs elsewhere only in the family Colobometridae, where the absence of one (rarely more) of the earlier pinnules (usually P_a) is widespread, being found in the genera *Petasometra*, *Cyllometra*, *Epimetra*, *Colobometra*, *Cotylometra* (by individual variation), *Prometra*, *Decametra*, and *Oligometra* (by individual variation). In the Macrophreata it reaches an extreme in the Atelecrinidae in the genus *Atelecrinus*, though the other genus of that family, *Atopocrinus*, has the full complement of pinnules. In the Pentametrocrinidae deficient pinnulation is characteristic of all the species of *Thaumatocrinus* and of some of the species of *Pentametrocrinus*. In the Antedonidae it occurs in *Balanometra* (Zenometrinae), and in *Hypalometra* and occasionally by individual variation in *Erythrometra* and *Perometra* (Perometrinae). Groups of perisomic interradials resembling those of *Comatilia* are characteristic of the Atlantic species of *Antedon*, of species of some closely allied genera, and of *Erythrometra*.

In *Comatilia* the mouth is central and the anal tube is small and marginal. Sacculi are sparingly present.

The single known species superficially suggests some of the small species of *Dorometra* and related genera, and until it is closely examined its true affinities are not suspected.

COMATILIA IRIDOMETRIFORMIS A. H. Clark

Plate 30, Figures 89–92

[See also vol. 1, pt. 1, fig. 235 (ventral view of centrodorsal), p. 249; fig. 326 (cirrus), p. 279; fig. 453 (dorsal view of radial pentagon), p. 355; pl. 2, figs. 528, 529 (young); pt. 2, figs. 13, 14 (centrodorsal and radials), p. 15; fig. 183 (lateral view), p. 98; fig. 237 (arm), p. 197; fig. 264 (arm and pinnules), p. 207; fig. 397 (covering plates), p. 245; figs. 592, 593 (pinnule tip), p. 303; figs. 616–618 (comb), p. 317; fig. 687 (disk), p. 341; figs. 763, 764 (covering plates), p. 353; figs. 803–805 (covering plates), p. 378]

Comatilia iridometriformis A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 366 (description; *Albatross* station 2670); p. 497 (type of *Comatilia*); Ann and Mag. Nat. Hist., ser. 8, vol. 5, 1910, p. 361 (development of side and covering plates the result of a deep water habitat).—Bather, Ann and Mag. Nat. Hist., ser. 9, vol. 1, No. 4, April 1918, p. 298 (interradials).—A. H. Clark, Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 7, fig. 43; The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).

Diagnostic features.—The absence of the second, third, and fourth pairs of pinnules, so that there are no pinnules between P_1 and P_a and P_5 and P_e, distinguishes this species at once. It is a very small form, the arms being only 30 mm. in length; the cirri are XVI–XXVIII, 9–10, from 5 mm. to 6 mm. in length, very slender and delicate, with the longest segment about four times as long as broad with expanded ends.

The general appearance of this species suggests one of the small antedonids much more than any of the other species of Comasteridae; but the characteristic comasterid comb is well developed.

Description.—The centrodorsal is moderate in size, discoidal, with the bare polar area flat, usually with a more or less developed low rounded median tubercle, from 1 to 1.5 mm. in diameter. The cirrus sockets are usually in a single, but often in a more or less partially double or even triple, marginal row.

The cirri are XVI–XXVIII, 9–10, from 5 to 6 mm. long, exceedingly slender and delicate. The first segment is short, about twice as broad as long, the second is about twice as long as broad, the third and fourth are the longest, about four times as long as broad, and the fifth is slightly shorter. The following segments gradually decrease in length, the antepenultimate being about half again as long as its distal diameter and the penultimate about as long as, or slightly longer than, broad. The second and following segments are strongly constricted centrally with expanded ends. After the fourth the proximal ends become less and the distal more expanded, the latter overlapping all around, but slightly more dorsally than ventrally, the dorsal overlap, however, exhibiting no tendency to project anteriorly. The opposing spine is terminal in position, directed obliquely forward, arising from the entire distal half (or rather more) of the dorsal side of the penultimate segment, about equal to one-half of the distal diameter of the segment in length, usually forking transversely in its distal half, more rarely breaking up into a number of small spines. The terminal claw is approximately equal in length to the penultimate segment, moderately stout and evenly curved.

The ends of the basal rays are visible as rather prominent tubercles in the interradial angles.

The radials are very short in the median line, but extend well up in the interradial angles and separate the bases of the IBr_1 for a distance about equal to one-half of the basal diameter of those ossicles. The IBr_1 are comparatively small, oblong, very short, between three and four times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, about twice as broad as long, the lateral edges about as long as those of the IBr_1 with which they make an obtuse angle.

Arms 10, about 30 mm. long. The first brachial is very short, oblong, about four times as broad as long, united basally with its fellow, but diverging from it at approximately a right angle distally. The second brachial is usually about twice as large, wedge-shaped. The first syzygial pair (third and fourth brachials) is somewhat longer than broad. The following brachials are very obliquely wedge-shaped, at first about as long as broad, but almost immediately becoming longer than broad and gradually increasing in length, being terminally two or three times as long as broad or even longer, with expanded ends. After about the sixth the brachials develop strongly produced and overlapping distal ends which are armed with a row of comparatively coarse spines.

Syzygies occur between brachials 3+4, again between brachials 13+14, and distally at intervals of 2 muscular articulations.

There are no pinnules on the fifth-tenth brachials, P_2, P_3, P_4, P_b, P_c, and P_d, being absent. P_1 is from 4 to 4.5 mm. long, slender and tapering evenly distally, composed of 20 segments, of which the first is not so long as broad, the second and third are about as long as broad, and the remainder are about half again as long as broad. The segments are somewhat constricted centrally and have expanded and overlapping distal ends which are armed with fine spines, and a finely spinous dorsal surface. The terminal comb is very prominent, composed of from 6 to 8 large teeth which are trapezoidal or bluntly triangular, their bases in contact, somewhat higher than the height of the segments which bear them, and recurved. P_a is similar to P_1. P_5 (the pinnule following P_1) is 3 mm. long with 12 segments, of which the first 2 are not so long as broad, the third is about as long as its proximal diameter, and the remainder are somewhat longer than broad. All but the first have greatly expanded distal ends armed with comparatively coarse spines. A strongly rounded and prominent gonad occupies the second-fourth or second-fifth segments. The following pinnules slowly increase in length, the segments, except the first 2, slowly becoming more and more elongated. The distal pinnules are about 4.5 mm. long, or about the length of the oral pinnules. The gonads occur on from 3 to 6 pinnules on either side of the arm and are always small and basally situated.

Large, conspicuous, and well-formed covering plates are present, 5 to each 2 pinnulars. These are considerably higher than the lateral diameter of the pinnulars, extend outward and slightly distally, and are somewhat more than twice as long as broad and strongly constricted centrally, so that they appear as two similar circles joined by a broad neck; their reticulation is very fine, and their borders are regular, though unfinished.

The integument over the gonads contains irregular plates and spicules of various sizes which are not in contact with each other.

The tentacles contain numerous spicules in the proximal portion.

Two to four large oval or circular perisomic interradials, which are usually not quite contiguous, are found in each interradial angle.

The disk, except for the perisomic interradials, is naked. The mouth is central and very large. The anal tube is small and marginal.

Sacculi are present on the pinnules, though they are not numerous.

Localities.—*Albatross* station 2670; off Brunswick, Ga. (lat. 31° 20′ 00″ N., long. 79° 22′ 00″ W.); 512 meters; temperature 6.95° C.; gray sand and dead coral; May 5, 1886 [A. H. Clark, 1909] (13, U.S.N.M., 14706, 25460, 34629, 34631).

Albatross station 2671; off Brunswick, Ga. (lat. 31° 20′ 00″ N., long. 79° 22′ 00″ W.); 512 meters; gray sand and dead coral; May 5, 1886 (18, U.S.N.M., 14699, 15975, 34626). Pl. 30, figs. 89–92.

Remarks.—This species has not been found since the original material was obtained.

Genus MICROCOMATULA A. H. Clark

Microcomatula A. H. Clark, Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 129 (*nomen nudum;* characteristic of the West Indian fauna; significance; appears to have been derived from *Comissia*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4 (in key); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies); p. 16 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range); p. 51 (in key).

Diagnosis.—A genus of Capillasterinae, including small species with 10 arms only and a central mouth; all the pinnules are present; the cirri are excessively slender and delicate with enormously elongated segments and swollen articulations; the first cirrus segment is longer than broad, and the penultimate, which is much shorter than those preceding, is twice as long as broad; the terminal comb on the oral pinnules consists of 3 very long lance-head-like teeth.

Geographical range.—Only known from the Virgin Islands.

Bathymetrical range.—Dredged between 91 and 183 meters.

Remarks.—The single species of *Microcomatula*, first described below, is the smallest of all the living crinoids, although it is only slightly smaller than the smallest species in the Antedonidae. It is interesting that, with so many giant forms which in bulk if not in arm length exceed all other comatulids, the family Comasteridae should include the very smallest living species. The next smallest species, together with the species with the greatest length of arm, belong to the family Antedonidae.

MICROCOMATULA MORTENSENI, sp. nov.

Description.—The centrodorsal is low hemispherical, almost entirely covered with cirrus sockets and with a very small bare dorsal pole; the cirrus sockets stand up some distance from the general surface.

The cirri are about XL, 8–9, the peripheral 4.5 mm. long, the apical about half that length, excessively slender and threadlike, with abruptly and conspicuously swollen articulations. The first segment is longer than broad, the second is about four times as long as broad or longer, and the following are greatly elongated, the third and fourth being the longest. Beyond the fourth the length diminishes to the antepenultimate which is four times as long as the median diameter and the penultimate which is wedge-shaped, increasing in diameter distally, and twice as long as its median diameter. The outer segments are laterally compressed. Under high magnification their distal dorsal edges are seen to be armed with fine spines and gabled in the middle, though the point of the gable is not produced. The opposing spine is large and prominent, conical and sharp, directed obliquely forward. The terminal claw is shorter than the penultimate segment, slender and evenly curved.

The radials are concealed by the centrodorsal except in the interradial angles, where they are produced anteriorly and separate rather widely the bases of the IBr_1 as in *Comatilia.* The IBr_1 are very short, from six to eight times as broad as long, with the proximal border more or less overlapped by the centrodorsal, the sides curving inward distally, and the distal border a very broad reentrant obtuse angle. The axillaries are much wider than long, the lateral edges very short and rapidly converging, making with the similarly converging sides of the IBr_1 somewhat less than a right angle, the proximal border a broadly obtuse angle.

The 10 arms are 12 mm. long. The brachials resemble those of *Comatilia;* their sides are rather strongly concave, and their edges and dorsal surface are finely spinous. The earlier brachials are about as long as broad, but distally they become elongated and four or five times as long as broad.

Syzygies occur between brachials 3 + 4, 8 + 9, 12 + 13, and distally at intervals of 2 muscular articulations.

The mouth is central and the anal tube marginal.

P_1 is long and very slender, with much elongated segments, the longest five or six times as long as broad, the distal becoming shorter, centrally constricted with finely spinous ends. The terminal comb consists of 3 very large lance-head-shaped teeth, which are much longer than the diameter of the segments which bear them. Apparently P_1, P_a, and P_2 bear combs; P_b and P_3 bear the first genital glands.

Locality.—Off Frederiksted, St. Croix (Santa Cruz), Virgin Islands; about 91–183 meters; Th. Mortensen, February 8, 1906 (1, type specimen, C. M.).

Remarks.—It gives me great pleasure to name this curious little species in honor of its discoverer, my friend Dr. Th. Mortensen.

Although so very small, the single known individual is evidently adult, having swollen genital glands. The exceedingly attenuated cirri represent a highly specialized character, for the first cirri to appear in all pentacrinoids are relatively stout with short segments—at least in the forms with elongated cirrus segments those in the cirri of the pentacrinoids are much shorter than those in the cirri of the adults. The terminal combs on the oral pinnules are quite unique in having only 3 teeth, and these teeth are remarkable for their extraordinary development, recalling the teeth in the very long combs of *Comatonia cristata.* The position of the second brachial syzygy, which is between brachials 8 + 9 instead of between brachials 9 + 10 as usual, is noteworthy.

Genus COMATONIA A. H. Clark

Antedon (part) P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 155.
Actinometra (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 280.

Comatonia A. H. Clark, Journ. Washington Acad. Sci., vol. 6, 1916, No. 5, p. 115 (type *Actinometra cristata* [P. H. Carpenter, MS.] Hartlaub, 1912; diagnosis; range); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4 (in key); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies); p. 15 (in key); The Danish *Ingolf* Exped., vol. 4, No. 5, Crinoidea, p. 39 (range); p. 51 (in key).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 229, footnote 1 (anomalous characters; possibly related to the Heliometrinae).

Diagnosis.—A genus of Capillasterinae including small species with 10 arms only, a central mouth, and prominent sacculi; the cirri, though slender, are not excessively so; there are no carinate processes on the basal segments of the proximal pinnules; terminal combs occur only on the pinnules of the first pair, P_1 and P_a, from one or both of which they may be absent; the combs usually arise about, or within, the proximal third of the pinnule and are composed of exceptionally large rounded teeth which usually much exceed in height the lateral diameter of the segments which bear them; the fourth-seventh brachials bear prominent spinous median knobs or keels; usually one or more of the earlier segments of P_1 are twice as long as broad, or even longer.

Geographical range.—From Key West, Fla., to Cape Lookout, N. C.

Bathymetrical range.—From 14 to 366 (?411) meters.

Thermal range.—Two records, 11.11° and 27 ° C.

Remarks.—The genus *Comatonia* is a most extraordinary type and, except for the enormous comb on the oral pinnules, can scarcely be said to resemble the other comasterids in any particular. But neither does it, except superficially, resemble any other type of comatulid.

Dr. Torsten Gislén has pointed out its anomalous characters and has suggested a possible relation to the subfamily Heliometrinae (Antedonidae). But the perfectly typical—indeed exaggerated— comasterid terminal combs seem to me to make its systematic position clear, expecially when *Comatilia* and *Microcomatula*, also curiously aberrant forms, are taken into consideration.

COMATONIA CRISTATA (Hartlaub)

Plate 6, Figures 17–20

[See also vol. 1, pt. 2, fig. 790 (adambulacral deposits), p. 372]

Antedon, sp. P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol 9, No. 4, 1881, p. 155 (distinguished by having enormous lancetlike processes on the lower joints of its oral pinnules; found among the large number of individuals of *A. hagenii* from the Florida Straits).

Actinometra cristata Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 413 (listed); pp. 473–475 (?locality; detailed description); pl. 10, figs. 1–5; pl. 15, figs. 10, 11.—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 4, footnote (type of *Comatonia;* off Cape Lookout, N. C., 7½ fathoms; near Key West, 120 and 132 fathoms.

Comatonia cristata A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 115 (range; only species in the genus); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 39 (range).

Diagnostic features.—This is a small and delicate species with slender arms not more than 50 mm. in length; the cirri are about XL, 14–17, about 13 mm. long, the peripheral cirri being markedly longer and stouter than the apical, an unusual condition in the Comasteridae.

The extraordinarily developed comb on the oral pinnules, combined with the presence of prominent spinous knobs or keels on the earlier brachials, at once distinguish this species from all others.

While it is scarcely possible to confuse this form with any other of the Comasteridae, its central mouth, its sacculi, its very small size and delicate build, and especially the fact that the division series and arm bases are closely appressed with the latter parallel to each other and to the dorsoventral axis, give it an appearance quite unlike that of any other comasterid, but much resembling that of many of the smaller forms among the Antedonidae, and it is very likely to be mistaken for some member of this family until the oral pinnules are examined.

Description.—The centrodorsal is hemispherical, almost completely covered with closely crowded cirrus sockets.

The cirri are about XL, 17, about 13 mm. long, fragile and deciduous, though not excessively slender. The apical cirri are markedly shorter and weaker than the peripheral and are composed of 14 segments. The 2 basal segments are short, the third is longer, and the fourth-eighth are much elongated. The fifth and sixth are the longest, nearly or quite three times as long as broad. The elongated segments are somewhat constricted centrally. Beyond the eighth the segments gradually decrease in length and become strongly compressed laterally. The third from the last is not longer than broad. The short distal segments have very slight terminal dorsal tubercles, and the opposing spine is well developed.

The radials are visible beyond the centrodorsal as narrow bands. The IBr_1 are short and are deeply incised distally by a rounded proximal process from the axillary which rises to a low broad and well-rounded synarthrial tubercle. The IBr_2 (axillaries) are rhombic, with a slight median groove in the distal portion and strongly concave distal sides.

The 10 arms are up to 50 mm. in length. The first brachials are short, longer exteriorly than interiorly, and are much incised by a rounded posterior process from the second which rises to a broad and well-rounded synarthrial tubercle. The second brachials are rhombic with a strong posterior process. The first syzygial pairs (composed of brachials 3+4) are about as long as the second brachials and cylindrical. The fifth brachial is of the same length, slightly wedge-shaped, the sixth is pronouncedly wedge-shaped and somewhat longer, and the seventh and eighth are similar to the sixth. The second syzygial pair (composed of brachials 9+10) is longer. The succeeding brachials, especially from the fourteenth onward, are triangular, except for the syzygial pairs, which are always elongated and trapezoidal. From the fifth to the eighth the brachials bear dorsally a knoblike or bluntly carinate process which is beset with exceedingly fine spines. The surface of the preceding and also of the succeeding brachials is everywhere smooth.

Syzygies occur between brachials 3+4, 9+10, 14+15, 18+19, 22+23, 26+27, and 30+31, sometimes between brachials 13+14, 17+18, and 22+23.

P_1 is composed of about 35 segments, of which the 4 basal are irregularly rhombic, being produced into a point dorsally, and are in contact only in the middle of their ends. The following segments are about as long as broad, increasing in width distally so that they overlap the base of the succeeding segment both dorsally and ventrally. Distally the segments gradually become elongated, so that those in the outer third are twice as long as broad or even longer. Usually one or more of the segments preceding the comb is more or less abruptly elongated, being twice as long as broad, or even longer. The comb is extremely long, usually arising at about, or within, the end of the proximal third of the pinnule, on about the tenth segment. The teeth soon become very long, in the outer half of the comb being two or three times the width of the segments in height. They have more or less parallel sides which are slightly constricted near the base and a broadly and evenly rounded tip.

Very often, sometimes in as many as half of the total number in an individual, P_1 does not bear a comb but simply tapers gradually to a slender pointed tip, being straight and more or less stiffened and composed of progressively elongated segments.

P_a resembles P_1 and may either bear a very long comb or taper gradually to a pointed tip.

P_2 is without a comb. It is straight, shorter than P_1, and tapers to a pointed tip. It is composed of increasingly elongated segments.

Hartlaub reproduced a figure which was originally drawn for Carpenter showing a pinnule consisting of 21 segments, of which the last 10 bear teeth. The first segment is nearly twice as broad as long, the second is about as long as broad, and those following increase in length so that the last before the comb is about four times as long as broad. Hartlaub believes that this represents P_2, but it is more likely that it represents P_1 or P_a of an intermediate type, as in the specimens which I have examined P_2 never shows any trace of a comb.

The following pinnules have the 2 basal segments short and the third and following greatly elongated.

The disk is about 4.5 mm. in diameter.

The mouth is approximately central. The anal tube is long. Sacculi are abundantly developed along the brachial and pinnule ambulacra.

The color in alcohol is uniform light yellow or yellowish white.

Notes.—In the 2 large specimens from the Pourtalès plateau the cirri are 15 mm. in length and are composed of 18–20 segments.

Localities.—*Fish Hawk* station 7302; Cape Lookout (North Carolina) Lighthouse bearing E. by N. ⅛ N., 1¾ miles distant; 14 meters; temperature 27.0° C.; hard sand; July 24, 1902 [A. H. Clark, 1918] (1, U.S.N.M., 34634). Pl. 6, fig. 20.

Fish Hawk station 7280; Gulf Stream, off Key West (lat. 24° 17′ N., long. 81° 58′ 25″ W.); 241 meters; temperature 11.11° C.; February 14, 1902 [A. H. Clark, 1918] (1, U.S.N.M., 34632).

Fish Hawk station 7298; Gulf Stream, off Key West (lat. 24° 19′ 00″ N., long. 81° 39′ 45″ W.); 219 meters; bottom temperature 18.5° C.; coral bottom; February 26, 1902 [A. H. Clark, 1918] (1, U.S.N.M., 34628). Pl. 6, fig. 19.

Off Key West, Fla.; about 146 meters (1, M. C. Z., 747).

Florida Keys; 172–229 meters (1, M. C. Z., 44 [part]).

University of Iowa's Bahamas expedition station 30; south of Key West; about 183 meters [H. L. Clark, 1918] (1, U. I. M.).

University of Iowa's Bahamas expedition station 48; southeast of Key West; about 146 meters [H. L. Clark, 1918] (2, U. I. M.).

Eolis; off Sambo Key, Fla.; 210 meters; John B. Henderson (1, U.S.N.M., E. 548). Pl. 6, figs. 17, 18.

Corwin station 1P; 5 miles southsouthwest of Sand Key, Fla.; 164–183 meters; May 17, 1867 [Hartlaub, 1912, as "Com. 101, Stn.—" = Corw. Po. 1, Stn. —].

Pourtalès plateau; 366–411 meters (2, M. C. Z., 755).

Geographical range.—From Cape Lookout, N. C., southward to the Florida Keys.

Bathymetrical range.—From 14 to 366 (?411) meters; the average of 10 records is 206 meters.

Thermal range.—There are two records, 18.5° C. and 27.0° C.; the average is 19.05° C.

Remarks.—In his preliminary report upon the *Blake* comatulids published in 1881 P. H. Carpenter wrote that among the large number of individuals of *Coccometra hagenii* from the Florida Straits he found a few examples of two entirely new species of "*Antedon.*" One of these was the form now known as *Hypalometra defecta.* The other is distinguished by having enormous lancetlike processes on the lower joints of its oral pinnules. Without question *Comatonia cristata* is the species to which this refers, for it is very commonly found associated with *Coccometra hagenii.* Carpenter, who had recently (1879) published an extensive memoir upon the Comasteridae (his genus *Actinometra*) based entirely upon a study of the highly specialized Indo-Pacific types, was not prepared to recognize this anomalous little creature with a central mouth and sacculi as related to them, and he therefore assigned it to the genus *Antedon* as understood by him. He speaks of the enormous lancetlike processes on the lower segments of the oral pinnules. In some cases nearly all the segments of these pinnules are involved in the comb, which is so extravagantly developed as almost to obscure its real nature.

When the *Blake* collection was turned over to him Hartlaub found in it a single specimen of this species without a locality label, and among the accompanying papers several excellent figures. (Pl. 10, figs. 1–5.) He gave a detailed description of the single individual, assigning it to the genus *Actinometra*, but pointing out that it strongly recalls an "*Antedon*" of the *Tenella* group. He did not suspect that it was the peculiar *Antedon* referred to by Carpenter in 1881.

Among the collections in the United States National Museum I had found several specimens of this species which were readily identified from Hartlaub's description and figures, so that when I established for it the genus *Comatonia* in 1916 I was able to indicate its range.

Dr. H. L. Clark in 1918 gave two localities at which it had been taken by the University of Iowa's Bahama expedition in 1893, and was so kind as to allow me to examine the specimens.

In 1924 Dr. Torsten Gislén remarked that this form deviates from all comasterids in having a rounded conical centrodorsal with the cirri in 3 or 4 rows, strong rounded posterior projections at the synarthrial articulations, and sacculi. He believes it to be a macrophreate form, possibly related to the Heliometrinae.

But I can not see any good reason for not considering it as a generalized representative of the Capillasteridae.

Subfamily COMACTINIINAE A. H. Clark

Comactiniinae A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (includes *Comatula*, *Comactinia*, and *Cominia* [*Comatulides*]); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 438 (2 genera and 6 species in Australia); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 390 (discussion of characters); Crinoids of the Indian Ocean, 1912, p. 6 (number of East Indian genera; number of genera also found in the Atlantic; number of genera represented by closely allied genera in the Atlantic; genera exclusively confined to the East Indies; number of East Indian species); p. 20 (distribution in detail); p. 54 (in key); Bull. de l'Institut océanographique, Monaco, No. 294, 1914, pp. 7, 8 (relations to temperature); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical range); No. 20, p. 582 (relation to temperature); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 4 and following (Atlantic and corresponding East Indian genera); Records of the Western Australian Museum, vol. 1, pt. 3, 1914, p. 114 (genera and species collected by the *Endeavour* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range and its phylogenetic and palaeontological significance); Amer. Journal of Science, vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical and thermal ranges; included genera and their bathymetrical ranges); p. 539 (genera with asymmetrical disks; genus with one or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 2 (in key); p. 24 (key to the included genera); University of Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (represented in West Indies); p. 25; Smithsonian Miscell. Coll., vol. 72, No. 7, 1921, p. 3.

Comactiniinés A. H. CLARK, Bull. du mus. d'hist. nat., Paris, No. 4, 1911, p. 247.

Diagnosis.—A subfamily of Comasteridae in which the cirri are usually short and strongly curved, and their outer segments are entirely without dorsal processes; the cirri are often entirely absent, and may be present only in the interradial angles of the centrodorsal; the arms are usually 10, but sometimes more than 10, though never more than 23, in number; when there are more than 10 arms the IIBr and IIIBr series are always 2 (1+2); following a IIBr or IIIBr axillary, and often following a IBr axillary, the first brachial syzygy, always on the outer arms and sometimes on both, is between brachials 1+2, and there is another syzygy between brachials 3+4; the genital pinnules are usually, but not invariably, noticeably broadened and are composed of very short segments.

Geographical range.—From southwestern Japan [?and the Society Islands] to the southern coast of Australia and westward to Ceylon; from Cape Lookout, N. C., southward throughout the Caribbean Sea and Gulf of Mexico to Rio de Janeiro, Brazil.

Bathymetrical range.—From the low-tide mark down to 984 meters. The relative frequency of the included genera at different depths is as follows:

0–100 meters	3	300–400 meters	2
100–200 meters	2	400–600 meters	2
200–300 meters	1	600–1,000 meters	1

Remarks.—The subfamily Comactiniinae is a small and fairly homogeneous group including only 4 genera. Three of the four genera (*Comatulella*, *Comactinia* and *Comatulides*) contain species with 10 arms only. Of the 7 species included in the fourth genus (*Comatula*) 5 have invariably 10 arms, 1 is normally 10-armed, but certain individuals occur with more than 10 (usually 11 or 12, but exceptionally as many as 17) arms, and the last has 20 arms.

In one genus (*Comatula*) the synarthry between the elements of the IBr series is replaced by a syzygy and the first 2 brachials are united by syzygy excepting only in certain individuals of two species (*pectinata* and *purpurea*).

The IIBr series, when present, are of two elements which are usually united by a more or less perfect syzygy, and on the outer arms arising from a IIBr series there is a syzygy between brachials 1 + 2 as well as between brachials 3 + 4, which is usually absent on the inner arms. The arm division, therefore, is of the same type as that characteristic of *Comatella* and *Neocomatella*.

In the exceptional individuals of *Comatula pectinata* which have more than 10 arms the additional arms arise in the usual way through loss of the original arm at the articulation between the first 2 brachials and the appearance on the stump of an axillary from which 2 similar arms arise.

But in *Comatula rotalaria* the original arms are not lost. The very young have 10 arms only. As they grow, in place of the usual P_1 there appears on each arm an arm bud which rapidly develops, forming a secondary (external) arm which reaches full size at about the same time as the primary arm which bears it. This type of arm reduplication is unique among the comatulids, but it should be considered in connection with the reduplication of the radials and postradial series in *Promachocrinus*.

Excepting in a single genus (*Comatula*) the cirri are always well developed, there being at least one complete row and usually more. In *Comatula* they may be in adult individuals wholly absent (*rotalaria*, *cratera*, and *micraster*), confined to the interradial angles of the centrodorsal where they occur singly or in pairs (*purpurea* and *tenuicirra*), irregularly deficient (some individuals of *solaris* and *pectinata*), or forming a complete circlet (most examples of *solaris* and *pectinata*).

The cirri are always wholly devoid of dorsal processes, except for a more or less developed opposing spine, composed of subequal segments which may be very short (*Comatulella*) or moderately long, and strongly recurved. They are usually short and stout, but exceptionally (*Comatulides*) rather long and slender.

Increase in the number of arms over 10 and partial or complete absence of cirri are confined to species or individuals occurring within the area bounded by Hong Kong, the Philippines, tropical Australia, and Ceylon. It may be recalled that it is only within this area that the species of Capillasterinae without cirri (*Capillaster macrobrachius*) is found.

History.—The subfamily Comactiniinae was established in 1909 to include the genera *Comatula*, *Comactinia*, and *Cominia;* the last name, being preoccupied, was later changed to *Comatulides*. The genus *Comatulella* was subsequently created for a species (*brachiolata*) at that time included in *Comatula*.

The Comactiniinae include all of the species referred by Dr. P. H. Carpenter to the *Solaris* group (herein included in the genera *Comatula* and *Comatulella*); one of the two species (*paucicirra* = *rotalaria*) included in the *Paucicirra* group, the other, not mentioned by name in the *Challenger* report but subsequently described as *Actinometra notata*, being a synonym of *Comatella stelligera*, a member of the subfamily Capillasterinae; and two of the forms (*echinoptera* and *meridionalis*) definitely referred to the *Echinoptera* group. Carpenter also referred to the *Echinoptera* group (*Neocomatella*) *pulchella* and (*Nemaster*) *rubiginosa*, both of which belong to the Capillasterinae. He remarked that he had "not seen more than half a dozen other individual representatives of the group in addition to the three already mentioned" (*echinoptera* [*meridionalis*], *pulchella* [which he also referred to the *Stelligera* group], and *rubiginosa*). One of this half dozen is *Leptonemaster venustus*, and some, at least, belong to the genus *Comissia;* another is the type specimen of Müller's *Comatula cumingii*. The last is a synonym of *Comatula pectinata*, while the genera *Leptonemaster* and *Comissia* belong to the Capillasterinae.

KEY TO THE GENERA OF THE SUBFAMILY COMACTINIINAE

a^1. More than 30 cirrus segments which, except the penultimate, are twice as broad as long or even broader (southern Australia, from Perth, Western Australia, to Port Phillip, Victoria; 0–18 meters) ---------- **Comatulella**, p. 295.

a^2. Fewer than 25 cirrus segments, of which at least some, and commonly all, are longer than broad; cirri occasionally absent.

  b^1. Elements of the IBr series short and broad and, usually with the first 2 brachials, in lateral apposition; segments of the genital pinnules short and broad, usually much broader than long in the basal half of the pinnule, and more or less produced distally; only exceptionally more than XX cirri, which are short and rather stout; cirri sometimes absent.

    c^1. Elements of the IBr series and first 2 brachials united by a more or less perfect syzygy, or at least the union is extremely close and shows externally no evidence of a median articular ridge; 2 or more of the basal segments of the proximal pinnules usually bear a prominent carinate process; arms 10–20, though usually 10; cirri may be absent (Ceylon and the Gulf of Martaban to Australia, south to between Fremantle and Geraldton, Western Australia, and Sandon Bluffs, New South Wales, northward to Hong Kong, the China Sea, and Luzon, and eastward possibly to the Society Islands; 0–109 meters) -------- **Comatula**, p. 302.

    c^2. Elements of the IBr series and first 2 brachials united by synarthry, the line of union appearing externally as 2 very narrow triangles converging to a common apex in the median line; no carinate processes on the basal segments of the proximal pinnules; arms never more than 10; cirri always present (Cape Lookout, N. C., southward throughout the Caribbean Sea to Rio de Janeiro, Brazil; 0–508 [?510] meters) ------ **Comactinia**, p. 374.

  b^2. Elements of the IBr series longer and narrow, widely free laterally; segments of the genital pinnules beyond the first 2 as long as, or longer than, broad; cirri XXIV–XL, long and slender, strongly compressed laterally; cirri always present; arms never more than 10 in number (southwestern Japan to the Lesser Sunda Islands; 311–984 meters) **Comatulides**, p. 400.

Genus COMATULELLA A. H. Clark

Comatula (part) Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 535, and following authors.

Alecto (part) J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 206.

Actinometra (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27, and following authors.

Comatulella A. H. Clark, Amer. Journ. Sci., ser. 4, vol. 32 (old ser. 182), No. 188, Aug. 1911, p. 130 (no diagnosis; used with the specific name *brachiolata* without explanation); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (confined to south Australia; closely related to *Comatula* which represents it in the East Indies); p. 447 (used to include [*Comatula*] *brachiolata* only); Crinoids of the Indian Ocean, 1912, p. 9 (confined to south Australia); Journ. Washington Acad. Sci., vol. 5, No. 1, 1915, p. 8 (confined to the Australian fauna; most closely related to *Comactinia*); Die Crinoiden der Antarktis, 1915, p. 167 (nearly related to *Comatula*); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetrical disk); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 24 (in key; range).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 59 (biseriality).

Diagnosis.—A genus of Comactiniinae including species in which the cirri are composed of more than 30 short segments, all of which, except the penultimate, are twice as broad as long or even broader. The 10 arms are short and broad. Stout ungrooved pinnules capable of being coiled dorsally occur at intervals among the distal pinnules.

Geographical range.—Southwestern and southern Australia, from Perth, Western Australia, to Port Phillip, Victoria.

Bathymetrical range.—From the shore line down to 18 meters.

Remarks.—This is the only crinoid type in which numerous pinnules are modified into grasping organs serving to supplement the cirri and the only recent type in which there is a definite suggestion of a biserial arrangement of the brachials. The very short jointed cirri are unique in the Comasteridae, though more or less similar cirri are found in various genera in other oligophreate families.

COMATULELLA BRACHIOLATA (Lamarck)

Plate 31, Figures 93, 94; Plate 32, Figures 95–97

[See also vol. 1, pt. 1, fig. 77 (dorsal view), p. 130; pt. 2, pl. 50, fig. 1332 (dorsal view)]

Comatula brachiolata Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 535 (description; ?Atlantic Ocean).—de Blainville, Dict. des. sci. nat., vol. 10, 1818, p. 108 (after Lamarck).—Lamouroux, Encyclop. méthodique, vol. 2, 1824, p. 206 (after Lamarck).—de Blainville, Dict. des sci. nat., vol. 60, 1830, p. 229 (after Lamarck); Manuel d'actinologie, 1834, 1836, p. 249 (after Lamarck).—Dujardin, in Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 471 (from Lamarck).—Deshayes and Milne-Edwards Hist. nat. des animaux sans vertèbres, ed. 2 vol. 3, 1840, p. 211 (after Lamarck).—J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 249.—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 201 (synonymy; description; ?Atlantic Ocean).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 5 (mouth excentric or even marginal); Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 517.—A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 150 (not known to occur with more than 10 arms); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 18 (arms compared with those of *Comanthus wahlbergii*); Bull. du mus. d'hist. nat., 1911, No. 4, p. 244 (=*Comatula brachiolata*); p. 247 (=*Alecto rosea:* ?locality; types are 2 small specimens collected by Quoy and Gaimard; description; recorded from Port Phillip); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 435 (history); Memoirs Australian Mus., vol. 4, 1911, p. 710 (history); p. 717 (known to Carpenter from Australia); p. 718 (recorded by Hartlaub, 1891); p. 722 (confined to south Australia; range); p. 733 (in key); p. 742 (annotated synonymy; characters; Port Phillip, King Georges Sound; a south Australian species; includes *Alecto rosea*); Crinoids of the Indian Ocean, 1912, p. 30 (identity of the type and of Müller's record); p. 79 (synonymy; localities; discussion of synonyms).

Alecto brachiolata J. Müller, Archiv f. Naturgesch., 1841, vol. 1, p. 142 (after Lamarck); 1843, vol. 1, p. 135 (redescribed).

Alecto rosea J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 206 (description; locality unknown); Archiv. f. Naturgesch., 1841, vol. 1, p. 143 (same); 1843, vol. 1, p. 132 (New Holland); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 206.—Beyrich, Abhandl. d. k. preuss. Akad. d. Wiss., 1857, 1858, p. 16 (comparison of the union of the elements of the IBr series with that in *Encrinus*).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 711 (history; identity); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 383 (identity).

Comatula rosea J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 250.—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 201 (synonymy; description; Australia).—W. B. Carpenter, Philos. Trans. Roy. Soc., vol. 156, 1866, p. 697 (distinct from *C. rosacea*).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27

(systematic position).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (synonym of *brachiolata*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 89 (B. M., MS.=*Comatulella brachiolata*).

Actinometra brachiolata P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed); p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 735 and following (discussion of Bell's method of formulation and corrected formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 57, 59, 278, 283, 366, 380.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 107 (dry specimen in the Leyden Mus. without locality; characters).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1583 (listed).—A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (specimen recorded by Hartlaub is *Comatula pectinata*); Memoirs Australian Mus., vol. 4, 1911, p. 716 (credited to Australia by P. H. Carpenter); p. 718 (Hartlaub's record); Crinoids of the Indian Ocean, 1912, pp. 35, 38, 112 (identity of previous records); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 75 (*Amphimetra discoidea* found under this name in the British Museum).

Actinometra rosea P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 517; Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 278 (no characters separate this form from *brachiolata*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (identity).

Comatulella brachiolata A. H. Clark, Amer. Journ. Sci., ser. 4, vol. 32 (old ser., vol. 182), No. 188, Aug. 1911, p. 130 (significance of distinctive characters); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (entirely different from the broad-armed variety of *Comatula pectinata* with which it was confused by Hartlaub); p. 441 (south Australia north to Perth and Port Phillip); p. 443 (range on the east coast); p. 444 (range on the west coast); p. 447 (localities; descriptions of specimens; discussion of the broadening of the arms and pseudobiserialism); p. 465 (association with other species); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 381 (specimen from Koombana Bay in U.S.N.M.); p. 383 (includes *Alecto rosea* J. Müller, 1841); p. 385 (includes *Actinometra rosea* P. H. Carpenter, 1888); p. 387 (detailed description; range); Crinoids of the Indian Ocean, 1912, p. 9 (confined to south Australia); pp. 30, 35 (identity of previous records); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 307, pl. 4, figs. 1, 2; Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 7 (Port Phillip); Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (collected by the *Endeavour* in Western Australia); p. 115 (south Australian species; occurrence in the vicinity of Perth established); p. 117 (between Fremantle and Geraldton; characters of the specimen; discussion of ungrooved pinnules, and of pinnules in general); Die Crinoiden der Antarktis, 1915, p. 124 (exhibits same characteristics as *Solanometra antarctica*); p. 167 (range); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr,. 1915, p. 226 (detailed account of the distribution in Australia).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 233 (southwest Australia, No. 5967).—Mortensen, Studies in the Development of Crinoids, 1920, p. 81, and footnote, p. 81 (prehensile pinnules).—A. H. Clark, Smiths. Miscell. Coll., vol. 72, No. 7, 1921, p. 7 (pinnules).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 56 (biseriality) p. 96 (pinnule articulations).

Diagnostic features.—The massive centrodorsal bearing cirri with more than 30 very short segments, the broad, short, rapidly tapering arms, and the occasional occurrence of stout grooveless pinnules among the slender distal pinnules easily distinguish this species from all its relatives.

Description.—The centrodorsal is very large and massive, thick discoidal, with a very slightly convex polar area 7 mm. in diameter. The cirrus sockets are arranged in a single crowded and slightly irregular marginal row.

The cirri are XX–XXII, 32–34, 15 mm. long, rather slender, decreasing slightly in lateral width from the base to about the eighth segment, then remaining of the same width until near the end, the terminal portion again tapering slightly. The first segment is very short and those following very gradually increase in length to the eighth, which, with those succeeding, is about twice as broad as long. The penultimate segment is about as long as broad. After the seventh or eighth segment the dorsal profile of the segments becomes very strongly, though evenly, convex, so that in a lateral view the dorsal profile of a cirrus as a whole is strongly scalloped. The opposing spine is small, blunt, and inconspicuous. The terminal claw is small and blunt.

The radials are concealed by the centrodorsal. The IBr_1 are very short, oblong, almost or quite united laterally. They are united to the IBr_2 (axillaries) by syzygy, the 2 ossicles together forming a pentagonal element which is about twice as broad as long. The IBr_2 are free laterally.

The 10 arms are apparently 60 or 65 mm. long. They are exceedingly stout in the basal half, the brachials measuring between 3 and 4 mm. in width. The dorsal surface of the arms is peculiarly flattened. The first brachial is exceedingly short, forming what appears superficially to be a syzygial pair with the second, this pair being wedge-shaped, about twice as broad as the median length, and interiorly united with its neighbor. The third and fourth brachials form a syzygial pair which is wedge-shaped and about twice as broad as the inner (greater) length. The following brachials are slightly wedge-shaped, about three times as broad as the median length, gradually becoming triangular, from two and one-half to three times as broad as the longer side. The whole arm presents an exceptionally rugged appearance.

P_1 is 13 mm. long and is composed of 30 segments, of which the first 3 or 4 are broader than long and the remainder are about as long as broad. None of the segments are carinate. The terminal comb has 11 teeth which are bluntly triangular, rather narrow basally, and about as high as the width of the segments bearing them. P_2 is similar but not so long, as stout basally as P_1, but, owing to the lesser length, tapering slightly more rapidly. P_3 is similar, 8.5 mm. long with 21 segments, almost all of which are broader than long, as stout basally as P_2 but becoming more slender distally. This pinnule bears no comb. The following pinnules are apparently similar to P_3, gradually becoming more slender distally with longer segments, the change taking place first in the distal portion of the pinnules and working toward the base, and slightly decreasing in length. The segments in the proximal part of the pinnules following P_3 are more or less produced in a thickened convexity dorsally, this feature dying away in the outer half of the pinnule and slowly disappearing from the pinnules in the distal half of the arm.

The preceding description is based upon the 2 fragmentary specimens which were originally described by Johannes Müller under the name of *Alecto rosea* in 1841.

In a specimen probably from the vicinity of Perth, Western Australia, all the arms possess ambulacral grooves, but in the proximal portion of some of the arms single pinnules, or groups of 2 or sometimes of 3, occur without grooves; in the outer part of the arms occasional pinnules are found to be grooveless. There appears to be no regularity in the occurrence of the grooveless pinnules, though the conditions can not be worked out with certainty because of the poor state of preservation of the specimen. The grooveless pinnules (vol. 1, pt. 2, pl. 50, fig. 1332) are at once recognizable through being very much stouter than the slender and delicate grooved pinnules. In contrast to the grooved pinnules, they are capable of being coiled dorsally, and they are commonly found wrapped about the organism to which the animal is clinging, quite after the manner of cirri.

In color the 2 specimens first described are yellow. That probably from Perth is light pinkish, becoming rose color on the calyx and arm bases; the cirri are light pinkish proximally but become rose color beyond the eighth segment.

Notes.—In the largest specimen from Koombana Bay the centrodorsal is large, thick discoidal, with a broad flat dorsal pole 4.5 mm. in diameter. The cirri are XIV, 32–35, 13 mm. long, and are arranged in a single slightly irregular marginal row. They taper gradually to about the eighth segment, being comparatively slender from that point onward.

The arms are 45 mm. long, very rugged and very stout, increasing gradually in width to about the twelfth brachial, from which point they taper rapidly to the tip. All the arms and almost all the pinnules possess ambulacral grooves. In this specimen the pinnules resemble the arms in being short. They are stout at the base but taper rapidly in the first 4 segments, being comparatively slender beyond. The distal pinnules are slender but short.

The two other specimens from Koombana Bay are similar to the one described.

The specimen probably from Perth is larger than those from Koombana Bay. The centrodorsal is thick discoidal with a large flat polar area 4.5 mm. in diameter. The cirri are XV, 32, 13 mm. long. They taper very noticeably to the eighth segment, but vary slightly or not at all from that point onward. The sixth–ninth segments are the longest, from half again to twice as broad as long. The remaining segments are subequal, all more than twice as broad as long. Up to the eighth the cirrus segments are light in color with a dull unpolished surface, but beyond that point they are deeper in color and possess a distinct polish. There is, however, no definitely marked transition segment. The cirrus segments are perfectly smooth without dorsal spines or other projections, but in lateral view the dorsal profile of the outer segments is seen to be very convex.

The anterior arms measure 65 mm. in length and the posterior 60 mm. The arms are short, stout, and rugged, tapering rapidly and ending quite abruptly, as is characteristic of the species.

The mouth is submarginal, just to the right of the base of the right derivative of the anterior ray.

In the specimen dredged by the *Endeavour* between Fremantle and Geraldton, which is an unusually fine example, the centrodorsal is thick discoidal with the dorsal pole large, very slightly convex (almost flat), 5 mm. in diameter.

The cirri are XVIII, 35–37 (usually the latter), from 15 to 18 mm. in length. They are arranged in one (with a partial second) irregular marginal row. All of the component segments are much broader than long. The cirri taper markedly for the first 7 segments.

The 10 arms are all of equal length and size, 85 mm. long, 2.5 mm. wide at the base, and 4.3 mm. wide at the broadest place, which is between the twelfth and fourteenth brachials.

The terminal comb on the proximal pinnules is composed of 15 teeth which are long and slender, shaped like an arrowhead with the point blunted.

All of the arms bear ungrooved pinnules in equal numbers. In the proximal portion of the arms the pinnules on either side typically alternate, grooved and ungrooved; further out there are 2 grooved pinnules between adjacent ungrooved pinnules, and toward the arm tips all the pinnules are grooved.

There is a very great difference in the structure of the grooved and ungrooved pinnules, which is well shown in the more proximal portion of the arm where the two types regularly alternate. The grooved pinnules, after the first 2 segments, which are rather large, are slender, delicate, and very flexible. The ungrooved pinnules have slightly larger basal segments than the grooved and taper very gradually, so that they are much stouter than the delicate grooved pinnules. At first the ungrooved pinnules lie horizontally, but in the distal half or third of the arms they curve dorsally into the form of a hook or spiral exactly as do the cirri, forming tendril-like attachments all along the arm, whereby the animal fixes each arm securely to the organisms on the sea floor in addition to fixing its central portion by means of its cirri.

The segments of the stout grooveless pinnules are produced dorsally into blunt rounded processes exactly resembling the dorsal convex swellings on the outer cirrus segments. These are perfectly smooth, with no trace of spines. These processes are entirely absent from the slender grooved pinnules which, instead, bear on the dorsal side of the terminal segments the long recurved spines characteristic of the pinnules of all the comasterids.

The color in life was purplish red, the centrodorsal and first 7 segments of the cirri darker and more brownish, the distal portion of the cirri bright red.

A dry specimen in the Leyden Museum recorded and described by Hartlaub has the centrodorsal rather thick discoidal with the circular dorsal pole slightly convex and about 6 mm. in diameter. The cirri are arranged in a single marginal row.

The cirri are apparently XV, 30–40+.

The single arm which is preserved entire is 50 mm. long.

P_1 and P_a are 10 mm. long and are composed of about 25 short segments, of which the 11 last are involved in the formation of the comb. The carination of the proximal segments of P_2 and P_b which is characteristic of *Comatula solaris* is lacking.

Hartlaub remarked that this individual in its general appearance closely resembles *Comatula solaris*, from which it differs in the much greater number of cirrus segments and the lesser number of segments in the proximal pinnules.

In the Paris Museum I have examined 2 small specimens without locality, but collected by Quoy and Gaimard. The larger has an arm length of only about 35 mm. The cirri are XII, 29–30.

In the British Museum I examined a remarkably fine specimen from Port Phillip, Victoria.

Abnormality.—In the specimen probably from Perth, on one arm, the right derivative from the left anterior ray as viewed from the ventral surface, the ambulacral grooves of 2 succeeding pinnules on the same side of the arm arise from the same point on the brachial ambulacral groove.

Localities.—?Vicinity of Perth, Western Australia; Hamburg southwest Australian Expedition, 1905 [A. H. Clark, 1911] (1, H. M.). Pl. 31, figs. 93, 94.

Endeavour; between Fremantle and Geraldton, Western Australia [A. H. Clark, 1914] (1, W. A. M.).

Hamburg southwest Australian expedition station 56; Koombana Bay, 6–7 miles southwest of Bunbury; 14.5–18 meters; rocky bottom, with a few plantlike organisms July 28, 1905 [A. H. Clark, 1911, 1912] (3, U.S.N.M., 34933; H. M.; Berl. M., 5967). Pl. 32, figs. 96, 97.

King George's Sound [A. H. Clark, 1911].

Port Phillip, near Melbourne, Victoria [A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Australia; Herr Preiss [J. Müller, 1849; Dujardin and Hupé, 1862; W. B. Carpenter, 1866; P. H. Carpenter, 1879, 1882, 1888; A. H. Clark, 1911, 1912, 1913] (2, Berl. M., 1048). Pl. 32, fig. 95.

No locality [J. Müller, 1841, 1849; P. H. Carpenter, 1879, 1888].

No locality [Hartlaub, 1891].

No locality; Quoy and Gaimard [A. H. Clark, 1911] (2, P. M.).

Erroneous locality.—?Atlantic Ocean [Lamarck, 1816].

Geographical range.—Southwestern and southern Australia, from Perth southward and eastward to Port Phillip, Victoria.

Bathymetrical range.—Inhabits shallow water, and has not been reported from a greater depth than 14.5–18 meters.

History.—This species was first described by Lamarck in 1816 under the name of *Comatula brachiolata*. The locality was given, with a query, as Atlantic Ocean.

In 1841, Prof. Johannes Müller described *Alecto rosea* from a specimen without locality in the Vienna Museum, and in 1843 he redescribed Lamarck's *Comatula brachiolata*, from notes taken in the Paris Museum by Dr. Franz Herrmann Troschel, in the following terms:

The entire dorsal surface of the centrodorsal is free, the cirri being arranged in a single marginal row. The cirri are XV, 31–36. There are 10 arms. The first 4 brachials are united in 2 syzygial pairs. The following brachials are strongly produced distally on alternate sides of the arm, these anterior processes forming blunted angles. The intersyzygial interval is from 4 to 7 muscular articulations. P_1 is the longest pinnule. The last 8 segments are produced into teeth as in *Comactinia echinoptera*. The segments of all the pinnules are strongly set off from each other so that the pinnules are moniliform.

In 1841 Müller had referred both *brachiolata* and *rosea* to the genus *Alecto*, and in 1843 he redescribed Lamarck's *brachiolata* under the name *Alecto brachiolata*.

In his monograph published in 1849 he referred both of these species to *Comatula*. He repeated his redescription of *Comatula brachiolata*, mentioning a dry specimen (or specimens) in the Paris Museum. The locality he gave as unknown. This was immediately followed by the description of *Comatula rosea* in the same terms he had used in 1841. He mentioned the type specimen in the Vienna Museum, and also others in the Berlin Museum which had been received from Australia ("Neuholland") through Preiss. He noted that *rosea* is very close to *brachiolata* though not identical with it, as it differs in the characters of the first pinnules.

Dujardin and Hupé in 1862 repeated Müller's redescription of *Comatula brachiolata* and added that the expanse is 100 mm.; the arms, therefore, would be about 50 mm.

in length. They also repeated his description of *Comatula rosea*, giving the habitat as Australia, but mentioning only the specimen in the Vienna Museum. The expanse was given as 135 mm.

Dr. P. H. Carpenter in 1879 referred *brachiolata* to *Actinometra* on the basis of notes made on an examination of the type in Paris. He referred *rosea* to *Actinometra* with a query, as he had not personally examined it. He remarked that "Müller says expressely that the first pinnules are not specially distinguished; but, except in this point, he regarded it as very closely related to *C. brachiolata*, which is a true *Actinometra*."

In the *Challenger* report (1888) Carpenter, who had been able since the publication of his previous paper to examine the specimens of *rosea* described by Müller both at Vienna and at Berlin, was able definitely to refer this form to Lamarck's *brachiolata*.

In his key to the species of the *Solaris* group of *Actinometra* he differentiated *brachiolata* from the two other species which he included (*pectinata* and *solaris*) on the basis of the greater number of cirrus segments (30–35), and the fact that the basal segments of the lower pinnules are not especially distinguished.

In 1891 Dr. Clemens Hartlaub recorded a dry specimen of this species without locality which he found in the Leyden Museum.

In 1911, I recorded 2 small specimens in the Paris Museum which had been collected by Quoy and Gaimard, but had with them no indication of locality. I did not see the dry specimen which had been described by Lamarck and subsequently redescribed by Müller, but I have little doubt but that it was originally one of the same lot. At the same time I recorded a specimen from Port Phillip which I had seen in the British Museum.

In another paper published in 1911 I recorded 3 specimens from Koombana Bay and another probably from the vicinity of Perth, describing 2 of these in detail.

In 1912, I redescribed the 2 specimens in the Berlin Museum which had been recorded by Müller in 1849 and which, thanks to the courtesy of Drs. W. Weltner and R. Hartmeyer, had been sent to me for examination.

In 1913, I published photographs of both surfaces of the specimen probably from the vicinity of Perth, and in 1914 I gave a detailed account of a specimen which had been dredged by the *Endeavour* on the coast of Western Australia.

Genus COMATULA Lamarck

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Sci., ser. 4, vol. 32 (old ser. vol. 182), 1911, p. 130 (significance of the 20-armed species in Australia); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (closely related to *Comatulella* which it represents in the East Indies; possesses 3 purely Australian species); Memoirs Australian Mus., vol. 4, part 15, 1911, pp. 730, 731 (in keys); p. 732 (key to the Australian species); p. 739 (original reference; characters; range; represented in the Caribbean Sea by *Comactinia*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 389 (affinities and relationships; characters); Crinoids of the Indian Ocean, 1912, p. 9 (possesses additional species in Australia); p. 10 (absent from Japan; reason); p. 11 (absent from the Andamans, west coast of the Malay peninsula, and further westward); p. 13 (corresponds to *Comactinia*); p. 54 (in key); p. 78 (original reference; type); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 4 and following (represents *Comactinia* of the Atlantic; range); Beiträge zur Kenntnis d. Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (corresponds to *Comactinia*); Die Crinoiden der Antarktis, 1915, p. 181 (range; represented in the Atlantic by *Comactinia*); Smiths. Miscell. Coll., vol. 65, No. 10, 1915, pp. 34 and following (phylogenetical study); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetrical disk; 1 or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 24 (in key; range); p. 25 (key to the species in the subgenus *Validia;* discussion); p. 26 (key to the species in the subgenus *Comatula*).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, p. 56 (discussion).

Alecto (part) Leach, Zool. Journ., vol. 1, 1825, p. 589, and following authors.

Comatules (?part) Férussac, Bull. des sci. nat., ser. 2, vol. 26, 1831, p. 183 (collected by Lamare-Picquot in the East Indies).

Actinometra J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 180 (diagnosis; genotype *Actinometra imperialis*); Archiv f. Naturgesch., 1841, vol. 1, p. 140 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 203; Archiv f. Naturgesch., 1843, vol. 1, p. 131; Monatsber. d. k. preuss. Akad. d. Wiss., 1846, p. 178.—Bronn, Die Klassen u. Ordnungen der Strahlenthiere, 1860, p. 206.—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, pp. 203, 208.—Gerstaeker, in Carus, Handb. d. Zool., vol. 2, 1863, p. 515.—Lütken, Vidensk. Meddel. fra den naturhist. Forening i Kjøbenhavn, 1864, p. 218.—Lovén, Canadian Naturalist, new ser., vol. 3, 1868, p. 441.—Pomel, Revue des échinodèrmes, 1869 p. liii.—Lütken, Mus. Godeffroy Cat., vol. 4, 1869, p. 125; Vidensk. Meddel. fra den naturhist. Forening i Kjøbenhavn, 1868, 1869, p. 161.—A. Agassiz, Ann. Lyceum Nat. Hist., New York, vol. 9, 1870, pp. 243, 244.—Claus, Grundzüge d. Zool., 1872, pp. 229, 230.—Lütken, Mus. Godeffroy Cat., vol. 5, 1874, p. 190.—Grube, Jahresber. d. schlesisch. Gesellsch. f. vaterl. Cultur, 1875, p. 75.—Claus, Grundzüge d. Zool., 1876, pp. 277, 279.—Ludwig, Nachr. Ges. Göttingen, 1876, p. 676.—Zittel, Handb. d. Palaeontol., vol. 1, 1876–1880, pp. 346, 397.—P. H. Carpenter, Journ. Anat. and Physiol., vol. 11, 1876, p. 89; vol. 12, 1877, p. 35; Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 440; Nature, vol. 15, Jan. 4, 1877, p. 197.—Ludwig, Zeitschr. f. wiss. Zool., vol. 29, 1877, p. 49.—P. H. Carpenter, Quart. Journ. Micros. Sci., vol. 18, 1878, p. 372; vol. 19, 1879, p. 186; Nature, vol. 19, 1879, p. 450; Proc. Roy. Soc., vol. 28, 1879, p. 385; Trans.

Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 1 and following (monographic account of the genus [that is, of the Comasteridae]).—Packard, Zoology, 1879, p. 101.—Wachsmuth and Springer, Proc. Acad. Nat. Sci. Philadelphia, 1879, p. 10 (radials); Revision of the Palaeocrinoidea, 1879, p. 10.—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 15, 1880, p. 191; Pop. Sci. Review, new ser., vol. 4, No. 15, 1880, p. 195; Quart. Journ. Geol. Soc., 1880, pp. 40, 41, 45, 52.—Claus, Grundzüge d. Zool., ed. 4, vol. 1, 1880, p. 335.—P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, pp. 152, 163.—Wachsmuth and Springer, Proc. Acad. Nat. Sci. Philadelphia, 1881, pp. 184, 198; Revision of the Palaeocrinoidea, 1881, pp. 10, 24.—Bell, Proc. Zool. Soc. London, 1882, p. 533.—P. H. Carpenter, Quart. Journ. Microsc. Sci., vol. 22, 1882, p. 373.—Ludwig, Mém. acad. sci. Bruxelles, vol. 44, 1881, 1882, p. 6.—Lütken, Dyreriget, 1882, p. 616.—P. H. Carpenter, Quart. Journ. Microsc. Sci., vol. 23, 1883, p. 610.—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 747.—Chapman, Trans. Roy. Soc. Canada, vol. 1, sect. 4, 1882, 1883, p. 115.—Perrier, Comptes rendus, vol. 96, No. 11, 1883, p. 725; Ann. and Mag. Nat. Hist., ser. 5, vol. 11, 1883, p. 294 (comparison with *Eudiocrinus*).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155.—P. H. Carpenter, Phil. Trans. Roy. Soc., 1883, pt. 3, 1884, p. 926; Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 369; Quart. Journ. Microsc. Sci., vol. 24, 1884, p. 324.—W. B. Carpenter, Proc. Roy. Soc., vol. 37, 1884, p. 72.—Claus, Traité de zool., 1884, p. 412.—Hoernes, Eléments de Palaeontologie, Palaeozoologie, 1884, p. 130.—Lockington, Standard Nat. Hist., vol. 1, 1884, p. 142.—Bell, Proc. Linn. Soc. New South Wales, vol. 9, 1884, 1885, p. 498.—P. H. Carpenter, Ann. and Mag. Nat. Hist., ser. 5, vol. 16, 1885, p. 102; *Challenger* Reports, Narrative, vol. 1, pt. 1, 1885, p. 310.—Claus and Sedgwick, Element. Text Book of Zool., 1885, pp. 286, 289.—Filhol, La vie au fond des mers, 1885, p. 206.—von Graff, *Challenger* Reports, Narrative, vol. 1, pt. 1, 1885, p. 317.—Ludwig, Synopsis d. Thierkunde, 3te Auflage, pt. 2, 1885. p. 948.—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1885, p. 435 (found by Döderlein to be extremely plentiful in Sagami Bay).—Wachsmuth and Springer, Proc. Acad. Nat. Sci. Philadelphia, 1885, p. 288; Revision of the Palaeocrinoidea, 1885, p. 66.—A. M. Marshall, Studies from the Biol. Lab. of Owen's College, vol. 1, 1886, p. 295.—Packard, Zoology, 1886, p. 101.—Perrier, Explorations sous marines, 1886, p. 275; Mémoire sur l'organisation et le développement de la comatule de la Meditérranée, 1886, p. 86 (anatomy).—P. H. Carpenter, Ann. and Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 20; Quart. Journ. Microsc. Sci., vol. 27, 1887, p. 385; Proc. Geol. Assoc., vol. 10, 1887, No. 1, p. 2; *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 266.—Rolleston and Jackson, Forms of Animal Life, 1888, p. 573.—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 21, 1889, pp. 304 and following (species collected at Mergui); p. 313 (ambulacral grooves).—Hamann, Jen. Zeitschr., vol. 23 (N. F. 16), 1889, p. 302.—de Loriol, Paléontol. franç., terrain jurassique, vol. 11, pt. 2, 1889, pp. 434, 531.—Neumayr, Die Stämme des Thierreichs, vol. 1, 1889, p. 482.—Nicholson and Lydekker, Manual of Palaeontol., 1889, p. 412.—Bather, Nat. Hist. of the Crinoidea, 1890, p. [2]; Ann. and Mag. Nat. Hist., ser. 6, vol. 5, 1890, p. 314.—Cuénot, Comptes rendus, vol. 111, No. 22, 1890, p. 838.—Hartlaub, Nachr. Ges. Göttingen, May 1890, pp. 170, 186.—MacMunn, Quart. Journ. Microsc. Sci., 1890, p. 59 (pigment).—Wachsmuth and Springer, Proc. Acad. Nat. Sci., Philadelphia, 1890, p. 372.—Bather, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 464.—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 24, 1891, pp. 5, 21.—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, No. 40, April 1891, pp. 386, 387; vol. 8, No. 44, Aug. 1891, pp. 180, 181.—Bather, Ann. and Mag. Nat. Hist., ser. 6, vol. 9, 1892, p. 59.—Parkes, Manchester Microsc. Soc. Trans., 1890, 1891, p. 44.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 101.—A. Agassiz, Mem. Mus. Comp. Zoöl., vol. 17. No. 2, 1892, p. 33, footnote.—Seeliger, Zool. Jahrb., vol. 6, Morphol., 1892, p. 394.—Perrier, Traité de zool., 1893, pp. 785, 801, 858.—Woods, Element. Palaeontology, 1893, p. 91.—Jaekel, Sitzungsber. d. Ges. Naturforsch. Freunde, Jahrg. 1893, No. 4, 1894, p. 106.—McMurrich, Text Book of Invertebr. Morphol., 1894, p. 542.—Hartlaub, Bull. Mus. Comp. Zoöl., vol. 27, No 4, 1895, p. 142.—Keller, Das Leben des Meeres, 1895, pp. 422, 428.—Nutting, Bull. Lab. Nat. Hist., Univ. Iowa, vol. 3, Nos. 1, 2, 1895, p. 76.—Bather, Royal Nat. 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Clark, Ann. and Mag. Nat. Hist., ser. 8, vol. 3, 1909, p. 308.—Oswald, Science Progress, No. 13, July 1909, p. 133.—Kirk, Proc. U. S. Nat. Mus., vol. 41, 1911, pp. 66, 95, 96, 97, 99, 125.—A. H. Clark, Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 6.—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 282, 413.—Reichensperger, Zeitschr. f. wiss. Zool., vol. 101, Heft 1–2, 1912, pp. 3 and following (anatomy).

Comatula (*Actinometra*) J. Müller, Abhandl. d. k. preus. Akad. d. Wiss., 1847, 1849, p. 246.—Kuhl and van Hasselt, in Herklots, Bijdragen tot de Dierkunde, vol. 9, 1869, p. 10.

Antedon (part) Wyville Thomson, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 537.

Actimometra P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 37 (typographical error).

Actynometra Filhol, La vie au fond des mers, 1885, pp. 212, 216.

Aclinometra Koehler, Mém. soc. zool. France, vol. 8, 1895, p. 420 (typographical error).

Actinometer Springer, Bull. Lab. Nat. Hist., Univ. Iowa, vol. 5, 1903, p. 220 (typographical error).

Actinomerta A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 91 (editorial error).

Diagnosis.—A genus of Comactiniinae including species in which there are not more than XX cirri with not more than 25 segments, of which at least some, and commonly all, are longer than broad. Cirri are occasionally absent, the centrodorsal being reduced to a pentagonal or stellate plate within the radial circlet. The arms are 10–27 in number, stout, frequently much broadened in the proximal portion, the anterior arms sometimes with the distal portion greatly elongated and attenuated. The elements of the division series are short and broad and, usually with the first 2 brachials, are in lateral contact with their neighbors on either side. The segments of the genital pinnules are short and broad, in the basal half of the pinnules usually much broader than long, and more or less produced distally.

Geographical range.—From Ceylon and the Gulf of Martaban to Australia, south to between Fremantle and Geraldton, Western Australia, and Sandon Bluffs, New South Wales, northward to Luzon, the China Sea, and Hong Kong, and eastward possibly to the Society Island.

Bathymetrical range.—From the shore line down to 109 meters.

Remarks.—The normally 20-armed species of this genus (*rotalaria*) has been set apart as the type of a special subgenus, *Validia*, chiefly on account of its curious method of arm reduplication, which is unique among living comatulids, though occurring in the pentacrinites. The 2 outer arms on each ray first appear as buds in the position of the usual P_1 on the original 10 arms. These buds develop into arms which reach the size of the 10 original—now inner—arms when the animal becomes adult.

In *Comatula pectinata*, which may have as many as 17 arms, the additional arms arise in the usual way by the breaking off of the original arm at the articulation between the first 2 brachials and the development of an axillary bearing 2 arms on the stump or exposed articular surface of the first brachial.

In arms arising from a IIBr axillary the first syzygy is between brachials 1+2, and on the outer arm this is immediately followed by another syzygy between brachials 3+4. The arm division in multibrachiate species or individuals of *Comatula* is therefore of the type characteristic of *Comatella* and its allies.

Most of the 10-armed species of *Comatula* are remarkable for the great diversity of their arm structure. The arms may be slender or stout, short, or very greatly elongated. Often the posterior arms are short and broad, the anterior very long and attenuated. In some cases as few as 4 of the 10 arms may bear ambulacral grooves.

KEY TO THE SUBGENERA OF COMATULA

a^1. Arms 20 (rarely more) in number; no cirri; in young individuals with cirri the outer arm on each IIBr series is smaller and shorter than the inner (Aru Islands and northern Australia south to Baudin Island, Western Australia, and Port Molle, Queensland; 0–69.4 meters) -- Validia, p. 308.

a^2. Arms less than 20, usually 10, in number; the 2 arms from the same axillary always of the same length; cirri usually, though not always, present (Ceylon and the Gulf of Martaban to Australia, south to between Fremantle and Geraldton, Western Australia, and Sandon Bluffs, New South Wales, northward to Luzon, the China Sea, and Hong Kong, and eastward possibly to the Society Islands; 0–109 meters)------------------- Comatula, p. 320.

Subgenus VALIDIA A. H. Clark

Comatula (part) LAMARCK, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 534, and following authors.

Alecto (part) J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 184.

Comatula (*Actinometra*) (part) J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 256.

Actinometra (part) P. H. CARPENTER, Proc. Roy. Soc., vol. 28, 1879, p. 390, and following authors.

Actynometra (part) FILHOL, La vie au fond des mers, 1885, p. 214.

Validia A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (characters; genotype *Comatula rotalaria* Lamarck, 1816); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 24 (in key to the genera of Comactiniinae; range).

Comatula (*Validia*) A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, pp. 6, 25.

Diagnosis.—A subgenus of *Comatula* including species in which the arms are usually 20 (from 18 to 27) in number. There are no cirri in the adult stage, the centrodorsal being reduced to a stellate plate sunken within the radial circlet.

The young possess 10 arms and cirri. The additional 10 arms develop from a bud which appears in the place of P_1 and grows into an outer arm. In young individuals, therefore, the outer arms of each IIBr series are smaller and shorter than the inner, not reaching the size of the inner arms until the animal is well grown and has lost all, or nearly all, the cirri.

Geographical range.—From the Aru Islands and northern Australia south to Baudin Island, Western Australia, and Port Molle, Queensland.

Bathymetrical range.—From the shore line down to 69.4 meters.

COMATULA ROTALARIA (Lamarck)

Plate 32, Figure 98

[See also vol. 1, pt. 1, fig. 78 (dorsal view of young), p. 131; figs. 151–159 (centrodorsal), p. 221; fig. 162 (dorsal view), p. 223; fig. 181 (dorsal view), p. 233; fig. 239 (ventral view of centrodorsal), p. 249; fig. 305 (3 united radials), p. 264; fig. 419 (basal ray), p. 321; pt. 2, fig. 121 (division series), p. 79; fig. 249 (arm), p. 199; figs. 391, 392 (arm tip), p. 245; figs. 629–631 (comb), p. 319; fig. 688 (disk), p. 341; pl. 1, figs. 958, 959 (radials); pl. 8, fig. 1020 (analysis of arm division); pl. 57, fig. 1364 (disk)]

Comatula rotalaria Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 534 (description; Australian Seas).—Lamouroux, Encyclop. méthodique, vol. 2, 1824, p. 205 (from Lamarck).—Dujardin, in Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 471 (from Lamarck).—Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 210 (from Lamarck).—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 204 (synonymy; description; Australia).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879 p. 5 (mouth excentric or even marginal).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 536 (types at Paris represent the species called *jukesii* by Carpenter and *paucicirra* by Bell); vol. 40, 1911, p. 19 (considered by Carpenter the same as *parvicirra*; but the types at Paris are conspecific with *jukesii* and *paucicirra;* Die Fauna Südwest-Australians, vol. 3, Lief. 13, 1911, p. 437 (northwest Australia, 8–15 fathoms); p. 440 (tropical Australian species occurring south to Holothuria Bank and Port Molle); p. 443 (range on east coast); p. 444 (range on west coast); p. 445 (summary of west Australian records); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (identity); p. 247 (includes *jukesii* and *paucicirra*; Australian Seas; record of the types); Memoirs Australian Mus., vol. 4, 1911, p. 710 (history); p. 717(known to P. H. Carpenter from Australia); p. 721 (occurs south to Port Molle); p. 723 (northwest Australia; Holothuria Bank); p. 724 (peculiar to north Australia); p. 732 (in key); p. 739 (annotated synonymy; characters; Albany Passage; Port Molle; description of specimens; arm division; additional Australian records; range; application of names); p. 799 (possible synonyms); Proc. Biol. Soc. Washington, vol. 25, 1911, p. 18 (arm structure compared with that of *Palaeocomatella*); Crinoids of the Indian Ocean, 1912, pp. 30, 31, 35, 39, 79 (synonymy; includes *rotalaria* Lamarck, *jukesii* P. H. Carpenter, *paucicirra* Bell and *aruensis* P. H. Carpenter; localities; discussion of the nomenclature); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 8 (published references to specimens in the British Museum; localities represented; notes).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 83 (Aru Is.).—A. H. Clark, Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 224 and following (detailed account of the distribution in Australia); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 275 (listed); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 11 (centrodorsal).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, pp. 5–7 (history); p. 15 (records); pp. 192 and following (range).

Comatula rotularis de Blainville, Dict. des sci. nat., vol. 10, 1818, p. 108 (from Lamarck).

Comatula rotularia de Blainville, Dict. des sci. nat., vol. 60, 1830, p. 229 (from Lamarck); Manuel d'actinologie, 1834, 1836, p. 249 (from Lamarck).—J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., April 1840, p. 93 (intersyzygial interval); Archiv f. Naturgesch., 1840, vol. 1, p. 311 (same).

Alecto rotalaria J. Müller, Monatsber. d. k. pruess. Akad. d. Wiss., 1841, p. 184 (from Lamarck); Archiv f. Naturgesch., 1841, vol. 1, p. 144 (from Lamarck); Archiv f. Naturgesch., 1843, vol. 1, p. 136 (redescribed).—Troschel and Ruthe, Handb. d. Zool., 1859, p. 584 (from J. Müller).

Comatula (Actinometra) rotalaria J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 256 (redescribed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Comatula, sp. P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 23, footnote 1.

Actinometra jukesii P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 390 (northeast coast of Australia).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 442 (Carpenter's emendation of this and similar names); vol. 39, 1911, p. 536 (identical with the species represented by the types of *Comatula rotalaria* at Paris); vol. 40, 1911, p. 19 (same).

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Comatula paucicirra A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (listed); vol. 35, 1908, p. 124 (listed); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203 (arm structure).

Comatula etheridgei A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 437 (history); p. 440 (Australian tropical species occurring south to Baudin I.); p. 444 (range on the west coast); p. 445 (summary of west Australian records); Memoirs Australian Mus., vol. 4, 1911, p. 723 (Holothuria Bank; Baudin I.); p. 724 (peculiar to north Australia); p. 733 (in key); p. 741 (description; localities; relationships; arm division); Crinoids of the Indian Ocean, 1912, p. 79 (references; locality); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 8 (published references to specimens in the British Museum; localities); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 224 and following (detailed account of the distribution in Australia).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour* 1909–1914, vol. 4, pt. 1, 1916, p. 6 (characteristic of the west Australian subregion).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 275 (listed).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, pp. 192 and following (range).

Comatula cotalaria A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 716 (typographical error).

Comatula (*Validia*) *rotalaria* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 6 (supposed by P. H. Carpenter to be closely related to *Actinometra notata* [*Comatella stelligera*]); p. 25 (in key; synonymy; station 273).

Comatula (*Validia*) *etheridgei* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 25 (in key; references; station 273); p. 26, fig. 1.

Comatula etheridgi Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 20.

Diagnostic features.—This is the only comatulid with 20 (18–27) arms, no cirri, and all the division series of 2 ossicles united by syzygy. It is also the only comatulid in which in young individuals the IIBr series bear arms of different lengths, the inner longer than the outer.

Description.—In fully developed individuals the centrodorsal is a thin flat plate wholly devoid of cirri, pentagonal or more or less sharply stellate, the flat, or sometimes slightly concave, dorsal surface of which is flush with the surface of the radials.

In young individuals the centrodorsal is small, thin discoidal, bearing a variable number of cirri which gradually drop off with increasing size as the centrodorsal slowly sinks within the radial ring.

The cirri, occurring only in the young, are X–O, 12–18. Most of the segments are longer than broad. The segments are smooth, without dorsal processes, but a small opposing spine is present. The cirri are slender and weak.

The radials are short and bandlike, in close lateral contact, forming a hollow pentagon, the interior of which is occupied by the centrodorsal. The IBr_1 are very short, about as long as, or commonly slightly shorter than, the radials, beyond which they form a hollow pentagon. The IBr_2 (axillaries) are united to the IBr_1 by syzygy. They are low triangular, from two to three times as broad as long or even broader, with the lateral angles slightly truncated and the short sides thus formed in contact.

In young individuals the IBr_1 are longer than the radials and widely free laterally, becoming gradually shorter and broader during growth until they come into close lateral contact. The IBr_2 are nearly pentagonal in the young and are widely separated, becoming gradually broader until their lateral borders, now reduced almost to a point, come into contact.

The IIBr series are 2 (1+2), very short, in close contact interiorly and, in large specimens, exteriorly also. The IIIBr series, if present, are 2 (1+2) and resemble the IIBr series.

The arms are usually 20 (from 18 to 27) in number, up to 165 mm. in length, and consist of about 150 brachials, of which the first 5 or 6 are nearly oblong, the following are almost triangular and usually half again as broad as long, and the distal are obliquely wedge-shaped.

Syzygies occur between brachials 1+2, on the 2 exterior arms of each postradial series also between brachials 3+4, again between brachials 9+10 or 11+12, the latter position being common on the outer arms, and distally at intervals of from 2 to 7 (usually 4 or 5) muscular articulations.

P_1 is long and tapering, up to 20 mm. in length, and consists of about 60 short segments, of which the lowest are rather broad and stout with prominent dorsal edges. It bears a large terminal comb. The next 4 or 5 brachials bear similar pinnules, which decrease rather rapidly in size and bear progressively smaller combs. Two, or sometimes three, of the basal segments are rather strongly carinate. The succeeding pinnules are less slender, with stouter segments, and increase slightly in length.

The mouth is radial and almost marginal. The anal area is more or less thickly covered with irregular plates, but the ambulacral grooves are unprotected.

The color in alcohol is reddish, yellowish, or grayish brown, bleaching to white, often with a dark mediodorsal stripe.

Description of young specimens.—In this species the 10 additional arms do not arise by adolescent autotomy as in the other multibrachiate comatulids, but in the small 10-armed young the second brachial develops, instead of the usual pinnule, an additional arm which gradually increases in size until it reaches the same dimensions as the original arm. The equalization of the arms, however, does not occur until the animal has reached almost the full size.

This manner of increasing the number of arms is, so far as known, unique among the recent comatulids, but there is a close parallel in the case of *Promachocrinus kerguelensis* (vol. 1, pt. 2, pp. 530–557), in which the so-called "interradial" rays and arms do not begin to form until after the first 5 (radial) rays and the 10 arms which they bear have attained a very considerable size, and do not attain the length and stoutness of the latter until the animal is almost fully grown.

Carpenter remarked that the 2 outside arms of each postradial series in young individuals are often much smaller than the 2 inner arms, and noted that this is especially distinct in those from the Aru Islands, in one of which, with an arm length of 100 mm., the outside arms are so small as to look like unusually developed pinnules.

In the youngest of the *Challenger* specimens from the Aru Islands as described by Carpenter there is a relatively large pinnule on the second brachial and a very small one on the third, but there are none on the next 4 brachials, though they reappear again on the eighth.

In 2 young specimens from Holothuria Bank and 1 from Baudin Island there are no cirri, but the centrodorsal is somewhat raised above the dorsal surface of the radial pentagon. Another specimen from Holothuria Bank possesses a few small, slender and weak cirri, each with 12 segments.

On each of the 10 arms P_1 is replaced by a small arm which is generally about two-thirds the length of the original arm.

In the specimen which served as the type of *Comatula etheridgei* the small outer arms are usually about two-thirds the length of the original arms, but they may be three-quarters of the length of those arms.

Another specimen is similar, but the outer arms are rather smaller.

A third is similar, but the outer arms are longer, reaching 20 mm.

In all these specimens the length of the long inner arms is about 70 mm.

The largest of the 5 young specimens from *Siboga* station 273 has the inner arms 45 mm. long and the longest outer arms 20 mm. in length. Some of the outer arms are not so long as the pinnules which they bear. These last taper abruptly and are composed of 6 brachials which decrease rapidly in width and do not bear pinnules, terminating at the fourth segment of the first pinnule. The cirri are VII, 12, 6 mm. long, very slender. All of the cirrus segments are subequal, rather more than half again as long as broad, without dorsal processes. The cirri are confined to the interradial angles of the centrodorsal, occurring in 2 pairs, with a single one at each of the remaining three angles.

A second specimen has the inner arms 40 mm. long and the outer up to 30 mm. in length. The cirri are VIII, in 4 interradial pairs.

A third example has the inner arms 40 mm. long and the outer up to 11 mm. in length. The cirri are VII, three occurring singly and the others in 2 interradial pairs.

A fourth has the inner arms 30 mm. long and the outer up to 10 mm. in length from the axillary. The cirri are VII, resembling those in the first described.

The last has the inner arms 30 mm. long; none of the short arms are longer than their first pinnule.

All of the specimens which I have examined are light yellow brown in color.

Notes.—Carpenter remarked that in the youngest specimens of this species which he examined the centrodorsal is a thin and slightly convex circular disk about 2 mm. in diameter which bears 5 pairs of cirri, 1 pair in each interradius. These cirri reach 6 mm. in length and consist of about 15 segments which are tolerably mature in their general characters.

The next stage is represented by a slightly older individual in which all the cirri have fallen away from the centrodorsal and the obliteration of their sockets has commenced.

In another specimen this process has been carried further and the centrodorsal has become more distinctly pentagonal, though it has progressed rather unequally, some of the sockets being much more obliterated than others.

In a later stage the centrodorsal is a thin pentagonal disk with the appearance of processes at some of its angles which Carpenter says are more probably, however, the ends of the basal rays.

In a full-grown specimen the surface of the centrodorsal is much more nearly flush with that of the radials, though it still retains its pentagonal shape.

In another case each angle of the pentagon is marked by a more or less deeply impressed pit in which the basal ray is sometimes visible.

Another specimen has a more rounded centrodorsal which is flush with the radials at its edges and shows the basal rays at its angles, while there are indications of pits at the distal angles of the sutures between the radials. The sides of the centrodorsal in this specimen are slightly concave, but this feature is much more marked in 2 others in which the shape of the centrodorsal is markedly stellate. In the first of these the centrodorsal, as viewed from the dorsal side, is above the level of the radial pentagon, but in the second it is relatively much lower, so that its surface is flush with that of the radials the proximal edges of which are convex, in correspondence with the stellate outline of the centrodorsal. In a similar case the centrodorsal is pentagonal.

The effect of the complete withdrawal of the centrodorsal into the radial pentagon is to make it entirely invisible in a side view of the animal, while the dorsal surface of the radial pentagon becomes very deeply hollowed for its reception instead of being slightly convex, as is more usually the case.

Carpenter noted that in this species the arms are most frequently 20 in number. Among 50 individuals which he examined he found only 1 which did not have the full complement of 10 IIBr series. In this one postradial series was entirely without them, so that the number of arms is reduced to 18. Of the other specimens studied, 32 had 20 arms, 9 had 21 arms, 7 had 22 arms, and 1 had 23 arms. The IIIBr series, when present, are always 2 (1+2) like the IIBr series.

Carpenter discussed the peculiar arrangement of the syzygies at the base of the arms. The first brachial syzygy is always between brachials 1+2, even when IIBr series are absent. On the 2 outer arms of each postradial series the next syzygy is between brachials 3+4, so that, according to Carpenter, the normal sequence of syzygies on these 2 outer arms is between brachials 1+2, 3+4, 12+13, and 17+18, whereas on the 2 adjacent inner arms it is between brachials 1+2, 9+10, and 14+15.

The amount of carination of the lower pinnules varies considerably. As a general rule the pinnules of the first pair (P_1 and P_a) have their basal segments somewhat produced toward the dorsal side, and in the next 2 pairs of pinnules the second and third segment have rather prominent keels, traces of which are sometimes visible as far as the twelfth or fifteenth brachial. The terminal comb, which is very well developed on the basal pinnules, becomes gradually smaller and disappears at about the sixth or seventh brachial.

The visceral mass is somewhat readily detached from the calyx, and the *Challenger* occasionally dredged it in an isolated condition. It is not so completely plated as that of *Comatula solaris* is, for the ambulacra are unprotected and the interradial areas are covered by larger and more nodular plates. But both species may have the calcareous deposits considerably reduced in extent, though they are rarely entirely absent.

In Professor Döderlein's specimens from Thursday Island, P_1 in individuals of about equal size, with an arm length of from 105 to 80 mm., is about 21 mm. long, with a comb occupying from one-third to one-fourth of the entire length. Most of these specimens have 20–21 arms, but one has 27. The position of the syzygies is quite variable. The syzygies on 2 rays of the individual with 27 arms are as follows (syzygial pairs being counted as single ossicles):

Ray I
a. 1, 2, 9, 14, 19, 24, etc.
b. 2, 12, 16, 21, 26, etc.
c. 1, 2, 9, 14, 19, 24, etc.
d. 1, 2, 9, 14, 19, 24, etc.
e. 2, 9, 14, 18, 23, etc.
f. 2, 10, 16, 20, 24, etc.
g. 1, 2, 8, 13, 18, 23, etc.

Ray II
a. 1, 2, 5, 10, 14, 19, 24, etc.
b. 1, 8, 13, 18, 23, etc.
c. 1, 5, 10, 15, 20, 25, etc.
d. 1, 2, 4, 9, 14, 18, 23, etc.

In color Professor Döderlein's specimens were whitish with red-brown arm furrows and spots on the pinnules.

In the British Museum I examined 2 small specimens from Prince of Wales channel in 9.1–12.8 meters, one of which now has III, the other IV cirri. These are the types of Bell's *Actinometra paucicirra*.

As described by Bell the centrodorsal is small, low, and rounded. The cirri are V–VI, 15–18, about 8 mm. long. A number of the cirrus segments are longer than broad. The opposing spine is exceedingly small. The radials are visible. The IBr_1 are very wide, but not in contact laterally. The elements of the IBr series are united by syzygy, and the IIBr series are 2 (1+2). The 20 arms are about 70 mm. long. The first 4 brachials are pretty regularly oblong, the fifth is faintly wedge-shaped; after this the wedge-shaped form becomes more marked, but the edges of the brachials do not overlap. Syzygies occur between brachials 1+2, 9+10, and 14+15, then at intervals of 4–6 muscular articulations. P_1 is longer than P_2, and P_3 is longer than P_4. P_1 alone is of any considerable size; its segments are produced into very prominent edges. The succeeding pinnules are small; further out they enlarge somewhat, but are never at all long. The disk is 7 mm. in diameter. There is a slight development of calcareous deposit between the bases of the arms. The color is creamy white, rather darker below.

The specimen collected by the *Alert* at Albany Island is large and typical with 20 arms.

Of the 2 specimens from Albany Passage, 1 has 19 and the other 20 arms.

The 2 specimens collected by the *Alert* in Torres Straits in 7.3 meters both have 20 arms. One has one cirrus stump remaining. In both the centrodorsal has not yet sunk to the level of the dorsal surface of the radials.

Of the 2 specimens from Port Molle, 1 is a fine large individual with 20 arms 120 mm. in length. The other is a young example with 20 arms 60 mm. long and the cirri VII, 15, 11 mm. long. The cirri are confined to the interradial angles of the centrodorsal, 3 of which have a single cirrus and the other 2 each a pair. The cirri are moderately slender. The first segment is very short, the second is not quite so long and broad, the third is slightly longer than broad, and the fourth and following are approximately equal, about half again as long as broad. The penultimate is about as long as broad. The more proximal segments are slightly constricted centrally, and the penultimate bears a small and short subterminal opposing spine. The terminal claw is half again as long as the penultimate segment, moderately and evenly curved.

The single adult from *Siboga* station 273 is a particularly fine example, with 20 arms 165 mm. long, the posterior arms being 120 mm. long. All of the arms are grooved, despite the difference in the length. The centrodorsal exactly fills the space between the radials, its surface being on precisely the same level as theirs, so that its borders are difficult to detect.

As redescribed by Müller from notes taken by Troschel, Lamarck's type specimens have a pentagon in the center of the dorsal surface. There are no cirri. The elements of the IBr series are united by syzygy. The IIBr series are 2 (1+2). The arms are 20–22, but normally 20, in number, 135 mm. long. They are stout, and the lateral borders of the brachials are straight. The intersyzygial interval is 4–6 muscular articulations. The first pinnules are very long, and those following decrease only slightly in size to the arm tips.

The specimen without locality in the British Museum is a fine example, with 21 arms. The centrodorsal is stellate and sunken to the level of the dorsal surface of the radials. There are no subradial clefts. The single IIIBr series is externally developed and resembles the IIBr series.

Abnormal specimens.—The *Challenger* dredged a 4-rayed individual in which the anterior ray is missing, so that the mouth lies in an interradius directly opposite that in which the anus is situated.

In a *Challenger* specimen recorded by Carpenter one of the postradial series lack IIBr series, so that it bears simply 2 undivided arms, the total number of arms in the individual being 18 instead of the usual 20. In this postradial series the IBr_1 is absent. On one of the 2 arms there is a syzygy between brachials 3+4 in addition to the usual syzygy between brachials 1+2, as is normally the case in the outer arms arising from IIBr series.

Localities.—Holothuria Bank, northwestern Australia; 62 meters [A. H. Clark, 1913] (1, B. M.).

Holothuria Bank [A. H. Clark, 1913] (1, B. M.).

Holothuria Bank, 69.4 meters [A. H. Clark, 1911, 1913] (3 young, B. M.).

Baudin Island, 14.6–27.4 meters [A. H. Clark, 1911, 1913] (2 young, B. M.).

Northwest Australia; this includes the four preceding localities; 14.6–27.4 meters [Bell, 1894].

Thursday Island [Bell, 1884]. Same [Döderlein, 1898].

Challenger station 187; off Booby Island, Torres Straits (lat. 10° 36′ S., long. 141° 55′ E.); 10.9 meters, coral mud; September 9, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (12, B. M.).

Challenger station 186; Prince of Wales Channel, Torres Straits (lat. 10° 30′ S., long. 142° 18′ E.); 14.6 meters; coral mud; September 8, 1874 (1, M. C. Z., 201).

Alert; Prince of Wales Channel, Torres Straits; 9.1–12.8 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (2, B. M.).

Alert; Prince of Wales Channel, Torres Straits; 12.8 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Alert; Albany Island, Queensland; 5.5–7.3 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Albany Passage [A. H. Clark, 1911] (2, U.S.N.M., 34928; Austr. M.). Pl. 32, fig. 98.

Cape York; Prof. J. Beete Jukes; H. M. S. *Fly*, 1843–1847 [P. H. Carpenter, 1879, 1888; A. H. Clark, 1913] (1, B. M.).

Challenger; channel between Albany Island and Somerset, Cape York; 14.6–21.9 meters; September 7, 1874 [P. H. Carpenter, 1887, 1888].

Alert; Torres Straits, 7.3 meters [A. H. Clark, 1913] (2, B. M.).

Port Molle, Queensland [Bell, 1885; A. H. Clark, 1911] (2, Austr. M.).

Siboga station 273; anchorage off Pulu Jedan, east coast of the Aru Islands; pearl banks; 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (1 adult and 5 young, U.S.N.M., E. 443; Amsterdam Mus.).

Challenger; Aru Islands; 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1+, B. M.).

Australian Seas [Lamarck, 1816; J. Müller, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1879, 1888; A. H. Clark, 1911] (2, P. M.).

No locality [A. H. Clark, 1913] (1, B. M.).

Geographical range.—From Baudin Island, Western Australia (lat. 14° 08′ S.), and Port Molle, Queensland (lat. 20° 30′ S.), to the Aru Islands.

Bathymetrical range.—Littoral, and down to 69.4 meters; the average of 11 definite records is 20.2 meters.

History.—This species was originally described as *Comatula rotalaria* by Lamarck in 1816. In 1843, under the name of *Alecto rotalaria*, it was carefully redescribed by Müller from notes made for him on the type specimens in the Paris Museum by Troschel. In 1862 Müller's redescription was republished by Dujardin and Hupé.

In his memoir on the genus *Actinometra* (1879) Carpenter mentioned three comatulids in the *Challenger* collection having an anomalous arm structure. He said that in two of them the first and second distichals and the first and second brachials are united by syzygies, like the second and third radials; that is, the IBr and IIBr series are 2 (1+2). These are the forms which at that time he called *Actinometra jukesii* and *Act. aruensis*, later (1888) uniting them under the name of *Actinometra paucicirra* Bell.

In 1879 Dr. P. H. Carpenter published the notes on the type specimens of *Comatula rotalaria* which he had made during a visit to the Paris Museum in 1876. He said:

> According to Müller there are only two radials in *Act. rotalaria* which are united by a syzygium, while they bear the distichal axillaries directly; and these are also syzygial segments. Although, like Müller, I examined Lamarck's original specimen of this species, I cannot confirm the above statement. It is true that only two radials are visible externally; but this is often the case in *Comatulae*, with a wide centrodorsal piece; and I was quite unable to satisfy myself

that they are united by a syzygium, as Müller describes, and as is the case with the second and third radials of *Act. solaris*, while I was equally unable to determine a syzygial union between the two segments of which the distichal series is composed. Lamarck's original specimen of this species in the Paris Museum is wrongly labelled *C. brevicirra*, Troschel.

The specimens to which he referred are 3 small examples of *Comanthus parvicirra* which had been brought from Australia by Péron and Lesueur, and he quite overlooked Lamarck's specimens of *Comatula rotalaria* which I found in 1910.

When the comatulids of the *Challenger* expedition were submitted to him for study by Sir Wyville Thomson in 1878, Carpenter found among them a very considerable number of specimens of this species. In looking over the collection in the British Museum he found others which had been dredged by Prof. J. Beete Jukes and also by the *Alert* in the northeast Australian region. These did not conform with the characters of *Comatula rotalaria* as given in his notes taken from what he supposed were they type specimens, and he therefore assumed that they represented a new species, which he called in his preliminary notice of the *Challenger* collection in 1879 *Actinometra jukesii.*

While at the British Museum he had told Professor Bell of this new form and had identified for him the specimens of it in the museum's collection.

In 1882 Bell, in his list of specific formulas for the various species of comatulids, mentioned *Actinometra jukesi* without comment, and gave a specific formula for another form from the *Alert* collection which he called *Actinometra paucicirra.*

In 1883 Carpenter published a specific formula for *Actinometra jukesi* and an emended formula for *Actinometra paucicirra.*

In 1884 Bell listed *Actinometra jukesi* from two localities where it had been dredged by the *Alert,* mentioning that it was a new species which would shortly be described by Carpenter, and described *Actinometra paucicirra* in detail.

In the *Challenger* report on the stalked crinoids (1884) Carpenter made frequent mention of *Actinometra jukesi.* He noted that it was common at Cape York, where isolated disks as well as complete individuals were dredged by the *Challenger,* that the mouth is radial and the disk, especially the anal area, is more or less beset with calcareous nodules, and that a parasitic isopod of the genus *Anilocra* (see vol. 1, pt. 2, p. 632), nearly half an inch long, is sometimes found in the anal tube. He described the transformation of the centrodorsal from the cirrus bearing form in the young to the sunken plate of the adult, and gave a specific formula both for the adult and for the young. He cited this species as typical of the *Actinometra jukesi* group of the genus *Actinometra,* which he characterized by the occurrence of IIBr 2 (1+2) series, and figured a disk showing the radial position of the mouth, a heavily plated anal area, and an isopod within the anal opening.

In 1885 Professor Bell recorded *Actinometra jukesi* from Port Molle, Queensland.

In 1888 Carpenter described in detail the specimens which had been collected by the *Challenger.* For these he used the name *Actinometra paucicirra,* as he had found that Bell's *Actinometra paucicirra,* of which a specific formula had been published in 1882 and which had been described in detail in 1884, was simply an immature stage of his *Actinometra jukesii* and not a distinct species as he had thought on his somewhat cursory examination of the specimens in the British Museum previous to the publication of the *Alert* report.

In the *Challenger* collection there were two immature specimens from the Aru Islands in which the outer arms on each ray are smaller than the two inner. He had at first considered these as representing a distinct species which he had called in manuscript *aruensis*, and this name appears on Plate 4 of his report, which was lettered in 1882. But he later decided that these simply represent a stage in the development of the individuals younger than that represented by Bell's *Actinometra paucicirra*.

In 1894 Bell recorded this species, as *Actinometra paucicirra*, from northwestern Australia in 8–15 fathoms, and in 1898 Prof. Ludwig Döderlein recorded it under the same name from Thursday Island.

In 1910 I visited the Paris Museum and there examined Lamarck's original specimens of *Comatula rotalaria* which I found to have been correctly described by Müller in 1843, and I also examined the specimens which Carpenter appears to have mistaken for the types. In a paper on some crinoids collected by the *Albatross* in the Philippines I mentioned that the types of *Comatula rotalaria* at Paris represent the form called *jukesii* by Carpenter and *paucicirra* by Bell, while the species which, following Carpenter, I had hitherto called *rotalaria* should bear the name *parvicirra*. This paper was published on February 15, 1911. Later in the same year in a paper on the crinoids of the Paris Museum I stated that Carpenter's *jukesii* and Bell's *paucicirra* were, as shown by an examination of the two types, synonyms of Lamarck's *Comatula rotalaria*, and toward the end of the year in a monograph of the recent crinoids of Australia I published a detailed synonymy of this species, under the name of *Comatula rotalaria*, at the same time recording additional specimens from Albany Passage and Port Molle in the collection of the Australian Museum.

In my account of the crinoids of Australia I described as a new species, *Comatula etheridgei*, 3 specimens from Holothuria Bank and 1 from Baudin Island in the collection of the British Museum, in which the outer arms arising from each IIBr series are much shorter than the inner. At the time Carpenter's mention of quite similar specimens from the Aru Islands had slipped my mind. My *Comatula etheridgei* is the equivalent of Carpenter's *Actinometra aruensis*, and both of these supposed forms are young individuals of *Comatula rotalaria*.

In the discussion of the distribution of the Australian crinoids which I published in 1911 in my report on the collection of the Hamburg southwest Australian expedition, *Comatula rotalaria* and *C. etheridgei* were treated in detail, and all previous records were cited.

In my memoir on the crinoids of the Indian Ocean (1912) I again noted the misapplication of the name *rotalaria* by Carpenter, and mentioned *C. etheridgei* as a valid species.

In 1918 I recorded both *Comatula* (*Validia*) *rotalaria* and *C.* (*V.*) *etheridgei* from *Siboga* station 273 and gave notes on the specimens. I remarked that it is quite possible that the latter is merely the young of the former.

Subgenus COMATULA Lamarck

Comatula A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 24 (characters); p. 26 (key to the included species).

Comatula (Comatula) A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 27.

Diagnosis.—A subgenus of *Comatula* including species in which the arms are never more than 17, and seldom more than 10, in number, and cirri are usually, though not always present. When there are more than 10 arms the 2 arms on each IIBr series are always of the same size, so that arm reduplication presumably is by the usual process of adolescent autonomy.

Geographical range.—From Ceylon and the Gulf of Martaban to Australia, south to between Fremantle and Geraldton, Western Australia, and Sandon Bluffs, New South Wales, northward to Luzon, the China Sea, and Hong Kong, eastward possibly to the Society Islands.

Bathymetrical range.—From the shore line down to 109 meters.

KEY TO THE SPECIES IN THE SUBGENUS COMATULA

a^1. No cirri, the centrodorsal being reduced to a pentagonal or stellate plate lying within the radial circlet.
  b^1. Anterior arms more than 100 mm. in length (Port Molle, Queensland, to Sandon Bluffs, New South Wales; 22–64 [?73] meters) ---------- **cratera**, p. 320
  b^2. Anterior arms not more than 65 mm. in length (Gulf of Martaban and the Andaman Islands to Lombok; 22–109 meters) ---------- **micraster**, p. 373.
a^2. Cirri present.
  b^1. Cirrus segments 16–25 (usually about 20) in number (Abrolhos Islands, Western Australia, and Port Curtis, Queensland, northward to Singapore and Hong Kong, eastward possibly to the Society Islands; 0–21.9 meters) ---------- **solaris**, p. 323
  b^2. Not more than 16 cirrus segments.
    c^1. Cirri distributed, regularly or irregularly, all around the periphery of the centrodorsal, without segregation in the interradial angles (Abrolhos Islands, Western Australia, and Port Curtis, Queensland, to Luzon and the China Sea, and westward to Ceylon; 0–73 meters) ---------- **pectinata**, p. 339.
    c^2. Cirri segregated in the interradial angles of the centrodorsal, where they occur singly or in pairs.
      d^1. Longest cirrus segments not much, if at all, longer than broad (from between Fremantle and Geraldton, Western Australia, and Port Molle, Queensland, northward to Singapore, the China Sea, and the Philippines; 0–93 meters) ---------- **purpurea**, p. 360.
      d^2. Longest cirrus segments twice as long as broad (Java Sea to Madoera; 82–88 meters) ---------- **tenuicirra**, p. 372.

COMATULA CRATERA H. L. Clark

Actinometra strota (part) BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 167 (Port Molle).

Actinometra solaris (part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 288 (Port Molle).

Comatula solaris (part) A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 743 (Port Molle); p. 744 (specimen from Port Molle with no cirri); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 8 (No. 8; Port Molle, 12 fathoms; *Alert*).

Comatula cratera H. L. CLARK, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, p. 4 (exclusively confined to the east Australian subregion); p. 12 (detailed description; 8 miles east of Sandon Bluffs, 35–40 fathoms); pl. 2, fig. 1.

Comatula solaris var. *solaris* A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 26 (in key; falls in c^1).

Diagnostic features.—The absence of cirri separates this form from *C. solaris,* with which otherwise it agrees in all the details of its structure.

Description.—The centrodorsal is pentagonal, sunken so that its dorsal surface is level with that of the radials, 4 mm. in diameter, with the sides straight or more or less concave.

The cirri are absent in 9 out of the 14 specimens on which the original description was based, and in the only other known. Three specimens have each a single small cirrus; one has 2 and one has 3 such cirri, each with 16–19 segments.

The IBr_1 are more than twice as long as the radials and half again as broad. The IBr_2 (axillaries) are triangular, nearly twice as broad as long.

The 10 arms are 175 mm. or more in length. The lowest brachials are nearly of equal length on the 2 sides and have more or less marked articular tubercules on their proximal margins; but these tubercles are never conspicuous. The brachials beyond the tenth are broadly triangular, the pinnule bearing side being three times as long as the side opposite. Their distal margins are slightly concave and project as a faint articular tubercle where the brachial is widest. These articular tubercles are not so marked as those in the earlier portion of the arm. The arms increase in width from the base, which is 4 mm. broad, to about 20 mm. from the base, where the width is 5 mm.; from this point they gradually taper distally; the width at 50 mm. from the base is 3.5 mm. There is a slight keel in the mediodorsal line of the arm which is better marked on some brachials than on others and differs in development in different specimens.

Syzygies occur between brachials 1+2 and 3+4 and then at intervals of 6–8 muscular articulations to about the thirtieth brachial, after which point the usual intersyzygial interval is 6 muscular articulations, though 5 or 7 occur frequently.

The disk of the type specimen is 13 mm. in diameter. The mouth is radial, not very close to the margin, with equally developed food grooves running to all the arms. There is no plating on the disk or on the ventral surface of the arms and pinnules, but the membrane covering the disk is, when fully dried, seen to be filled with calcareous granules of very small size.

P_1 is from about 20 to about 25 mm. in length, and is composed of about 45 segments, of which not more than 12–15 are involved in the formation of the small terminal comb. The following pinnules become successively shorter to P_8, which is about 16 mm. long, and is composed of about 25 segments. Beyond P_8 the pinnules gradually lengthen and become more slender, until they may exceed 20 mm. in length and have 35 segments. Terminal combs are confined to the first 3 pairs of pinnules. The basal segments on all the pinnules are much broader than long and somewhat compressed, especially on the distal margin. On P_2, P_3, P_a, and P_b this compressed distal margin becomes a conspicuous projecting keel on the second and third segments.

The color, in alcohol or dried, is light fawn color with or without purple markings. Dr. H. L. Clark suggests that perhaps in life all would show these purple markings more or less clearly. When well developed they appear as longitudinal stripes, one on each side of each arm, with a branch running up each pinnule. Distally the stripes fade away altogether. Proximally the stripes on the inner side of a pair of arms unite at the tip of the axillary from which they arise, while those on the outer side broaden out and cover the IBr series except for a narrow median area. Even the centrodorsal may be purplish. The disk and oral surface of the arms are yellowish, quite yellow when dry.

Notes.—A narrow and low carination runs along the arms to the tip in all the specimens which I have examined.

The example from Port Molle is a fine representative of the species. The centrodorsal is reduced to a pentagonal plate which has not quite sunken to the level of the radials.

Localities.—Alert; Port Molle, Queensland, 22 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913; H. L. Clark, 1916] (1, B. M.).

Endeavour; 8 miles east of Sandon Bluffs, New South Wales; 64–73 meters [H. L. Clark, 1916] (4, M. C. Z., 709, 721).

Remarks.—In his discussion of *Comatula solaris* in the *Challenger* report (1888) Carpenter remarked that the centrodorsal of the large Vienna specimen (the type of *Actinometra imperialis* J. Müller, 1841) has lost all trace of the cirrus sockets on one side and is almost reduced to a level with the radials, while in an *Alert* specimen from Port Molle the cirrus sockets are all obliterated, leaving nothing but a thin flat plate, very much as in some forms of *Comatula rotalaria.* He noted, futher, that in this specimen from Port Molle the disk is perfectly soft and membranous.

I examined the specimen from Port Molle in 1910 and published a note on it in 1913.

In 1916 Dr. Hubert Lyman Clark in his description of *Comatula cratera* remarked that whether this fine comatulid should be considered distinct from *C. solaris* is, of course, a matter of opinion. He recalled that the locality where it was dredged is some 400 miles south of the most southerly locality from which *C. solaris* has been recorded, and that the depth is considerably greater than any depth which has been published for that species.

In view of these facts he believed that the absence of cirri and the reduction of the centrodorsal, combined with the different terminal combs of the oral pinnules and the absence of plating on the disk and on the oral surface of the arm bases, warrant the recognition of the form by a different name.

In *C. solaris* the terminal comb of P_1, according to Doctor Clark, consists of 35–40 segments and occupies nearly half the pinnule, while the shape of the individual teeth is, moreover, very different from that seen in the combs of *C. cratera.*

He says that the specimen dredged by the *Alert* at Port Molle and referred to *C. solaris* by Carpenter, but specially discussed because of the absence of cirri and the unplated disk, is very possibly a specimen of *C. cratera;* but he does not mention the suppression of the cirri in one-half of the centrodorsal in the type of *Actinometra imperialis.*

In 1918 I regarded the specimens both with and without cirri as representing *C. solaris,* and so assigned them in the key to the species of *Comatula* published in the *Siboga* report. I had not at that time seen Doctor Clark's description of *C. cratera.*

While undoubtedly *C. cratera* is merely a form of *C. solaris*, related to it in much the same way that *C. purpurea* is to *C. pectinata*, it is well worth while to call attention to it by designating it with a special name, at any rate until we know far more about these animals than we do now.

COMATULA SOLARIS Lamarck

Plate 33, Figure 99

[See also vol. 1, pt. 1, figs. 148, 149 (centrodorsal), p. 220; fig. 237, 238 (ventral view of centrodorsal), p. 249; figs. 441–444 (radials), p. 351; figs. 455, 456 (dorsal view of radial pentagon), p. 355; part 2, fig. 256 (arm), p. 205; fig. 262 (arm and pinnules), p. 207; figs. 393, 394 (pinnule tip), p. 245 figs. 619–621 (comb), p. 319; pl. 1, figs. 960–962 (centrodorsal and radials); pl. 23, fig. 1142 (portion of dry disk); pl. 26, fig. 1165 (section of ambulacrum on disk)]

Comatula solaris Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 533 (description; Australian Seas).—de Blainville, Dict. des sci. nat., vol. 10, 1818, p. 108 (from Lamarck).—Lamouroux, Encyclop. méthodique, vol. 2, 1824, p. 205 (from Lamarck).—de Blainville, Dict. des sci. nat., vol. 60, 1830, p. 299 (from Lamarck); Manuel d'actinologie, 1834, 1836, p. 249 (from Lamarck).—Dujardin, in Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 470 (from Lamarck).—[Owen], Descript. and Illustr. Cat. Physiol. Series of Comp. Anat. contained in the Mus. Roy. Coll. Surgeons in London, vol. 4, 1838, p. 10, No. 2239 (ova); vol. 5, 1840, p. 15, No. 2928 (ovaria).—Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 209 (from Lamarck).—J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 218.—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 200 (synonymy; description; seas of India); p. 203 (the *Comatula solaris* of the Vienna Mus. was assigned to *Actinometra* by Müller).—P. H. Carpenter, Nature, vol. 15, Jan. 4, 1877, p. 197; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 5 (mouth eccentric, or even marginal).—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, No. 40, April 1891, p. 387 (type of *Actinometra*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (listed); vol. 35, 1908, p. 124 (listed); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 148 (synonymy; includes *robusta* Lütken; Australia); p. 150 (not known to occur with more than 10 arms); p. 193 (known from Singapore); Proc. U. S. Nat. Mus., vol. 40, 1911, pp. 3, 15, footnote (recorded by von Martens from Zanzibar; probably *Tropiometra carinata*); Amer. Journ. Sci., ser. 4, vol. 32, p. 130 (significance of the Australian variety); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (identity); p. 247 (Australian Seas); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (Arafura Sea and Dundas Strait); p. 439 (East Indian species occurring south to Holothuria Bank and Port Curtis); p. 443 (range on east coast); p. 444 (range on west coast); p. 445 (summary of west Australian records); Memoirs Australian Mus., vol. 4, 1911, p. 710 (history); p. 717 (known to Carpenter from Australia); p. 722 (occurs south to Port Curtis); p. 733 (in key); p. 743 (annotated synonymy; characters; localities; summary of Australian records; range; broad-armed form only in Australia; never more than 10 arms; specimen with a sunken centrodorsal and no cirri); p. 799 (possibly the species referred to by Walther, 1894); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (*Actinometra robusta* P. H. Carpenter, 1882, is a synonym of this species; Australia, type of *robusta;* Singapore, description; Rockhampton, Queensland; broad-armed type confined to Australia); Crinoids of the Indian Ocean, 1912, p. 17 (Australian specimens have the characters greatly accentuated over those from other regions); p. 21 (range closely parallels that of the genus *Zygometra);* pp. 29, 30, 31, 35, 38, 39 (identity of previous records); p. 79 (synonymy; summary of published records; characters; record from Zanzibar probably refers to *Tropiometra carinata*); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 8 (published references to specimens in the British Museum; localities represented; characters of the specimens).—H. L.

Clark, Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 134 (coast of Western Australia; the "broad-armed and generally robust phase"; unicolor, almost black).—Apstein, Sitzungsber. d. Gesellsch. naturf. Freunde zu Berlin, No. 5, May 1915, p. 129.—A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, p. 222 and following (detailed account of the distribution in Australia).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, 1916, pt. 1, p. 13 (comparison with *C. cratera*); The Echinoderm Fauna of Torres Strait, 1921, pp. 5–7 (history); p. 15 (range; not found by the Carnegie Exped.); p. 117 (host of *Ophiophthirius actinometrae*); p. 192 and following (range); Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Abrolhos Is.); p. 233 (East Wallaby I.; characters; Long I.).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 41 (details of arms).

Alecto solaris J. Müller, Archiv f. Naturgesch., 1840, vol. 1, p. 142 (after Lamarck); 1843, vol. 1, p. 135 (same).

Actinometra imperialis J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss, 1841, p. 181 (description; locality unknown); Archiv f. Naturgesch., 1841, vol. 1, p. 140 (same); 1843, vol. 1, p. 132; Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, pp. 216, 226.—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 209 (synonymy; description; no locality).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 11 (based upon an unusually large dry specimen of *Comatula solaris*).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 711 (history; same as *Comatula solaris*).

Comatula (*Actinometra*) *solaris* J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 248.—P. H. Carpenter, Nature, vol. 15, Jan. 4, 1877, p. 197; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 12 (example of Müller's terminology for an exocyclic form).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Antedon solaris Wyville Thomson, Philos. Trans. Roy. Soc., vol. 155, 1865, p. 537 (plating of the disk).

Actinometra solaris P. H. Carpenter, Nature, vol. 15, Jan. 4, 1877, p. 197; Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 443; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 11 (*Actinometra imperialis* a synonym of this species); p. 27 (systematic position); p. 39 and following (structure and anatomy [Singapore]); pl. 1, figs. 2, 5; pl. 5, figs. 1–4; Proc. Roy. Soc., vol. 28, 1879, p. 386; Nature, vol. 19, 1879, p. 450; Journ. Anat. and Physiol., vol. 11, 1879, p. 91 (anatomy); Popular Sci. Review, vol. 4, No. 15, 1880, pl. 6, fig. 11 (disk); Notes from the Leyden Mus., vol. 3, 1881, p. 192 (Cape Bantano).—Bell, Proc. Zool. Soc. London, 1882, p. 534 (listed); p. 535 (specific formula).—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 514; Proc. Zool. Soc. London, 1882, 1883, p. 734 and following (discussion of Bell's method of formulation and corrected formula).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 164 (localities; characters of the specimens and of the species); pl. 14, figs. A, *a*.—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, pp. 10, 49, 51, 52, 58, 91, 280.—Bell, Proc. Linn. Soc. New South Wales, vol. 9, 1884, 1885, p. 498 (Australia).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1886, p. 480 (cirri); Ann. and Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 84; *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 288 (description; Cape York; between Albany I. and Somerset; station 187; other localities; discussion); pl. 5, figs. 4, *a–c*; pl. 53, figs. 1–14.—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; from von Graff).—Cuénot, Archives de biol., vol. 11, 1891, p. 315 (anatomy).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 107 (China Sea; cirrus characters); p. 113 (in Göttingen Mus.).—Bather, Ann. Rep. Museums Assoc. for 1891, 1892, p. 97 (example of a recent crinoid).—Döderlein, Denkschr. d. medicin.-naturwiss. Gesellsch. Jena, ser. 8, vol. 5, 1898, p. 478 (Thursday I.); pp. 484, 486 (*Ophiophthirius actinometrae* symbiotic on cirri; Thursday I.).—Springer, Mem. Mus. Comp. Zoöl., vol. 25, No. 1, 1901, p. 51 (comparison with *Uintacrinus*).—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, pp. 172, 193 (syzygies and regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1583 (listed).—Steinmann, Die geol. Grundlagen d. Abstammungslehre, 1908, p. 157 (comparison with *Uintacrinus*); fig. 85, p. 157 (dorsa view, and pinnule); fig. 86, p. 158 (disk).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 714 (of Bell, 1884=*Comatula solaris*); p. 715 (of Bell, 1885=*Comatula solaris*); p. 716 (of P. H. Carpenter, 1888=*Comatula solaris;* credited to Australia by Carpenter); p. 720 (of Döderlein, 1898=*Comatula solaris*); Crinoids of the Indian Ocean, 1912, pp. 31, 35, 38, 39 (identity of previous records); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (of Bell, 1884=*Comatula solaris*+*C. purpurea*+*C. pectinata*+*Amphimetra crenulata*).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, pp. 5, 7 (identity).

Actinometra robusta (Lütken, MS.) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position); p. 29, footnote 3 (named but not described by Lütken); p. 61 (arrangement of cirrus sockets on the centrodorsal); pp. 86–92 (structure); pl. 5, figs. 10–15 (details of the dorsal pentagon).—P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 163 (detailed account of the plating of the disk); Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 517 (description; Australia); Proc. Zool. Soc. London, 1882, 1883, pp. 735 and following (discussion of Bell's method of formulation and specific formula).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 166 (comparison with *Actinometra solaris* and *A. intermedia*); p. 167 (Port Curtis; station 144 ["probably Thursday I."]; characters of the specimens); pl. 14, fig. A, *c*.—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 144 (arm bases compared with those of fossil species); vol. 26, pt. 60, 1888, pp. 59, 264, 278, 282, 283, 288–290 (structure; synonym of *solaris*).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 107 (confirms Carpenter in considering this a synonym of *solaris*).—Parkes, Manchester Microsc. Soc. Trans., 1890, 1891, p. 44.—Kirk, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 77 (comparison of arm bases with those of fossil comatulids).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 713 (history; identity); p. 714 (of Bell, 1884=*Comatula solaris*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (of Lütken and P. H. Carpenter=*Comatula solaris*); Crinoids of the Indian Ocean, 1912, p. 31 (of Bell, 1884=*Comatula solaris*).

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Actinometra striata PERRIER, Mémoire sur l'organisation et le dévéloppement de la Comatule de la Méditerranée, 1886, p. 107 (coloring matter; from Moseley, through Carpenter).—BRAUN, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes).

Antedon (*Actinometra*) *robustum* (Lütken, MS.) A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 146.

Actinometra echinoptera var. *meridionalis* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 417 (Hong Kong).

Comatula (*Comatula*) *solaris* A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 26 (in key; range); p. 27 (same).

Comatula (*Comatula*) *solaris* var. *hamata* A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, pp. 26, 27 (in key; range).

Comatula (*Comatula*) *solaris* var. *solaris* A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, pp. 26, 27 (in key; range).

Diagnostic features.—The large size and the occurrence of cirri which are composed of 16–25 (usually about 20) segments separate this species from all the others in the subgenus. The arms seem to be invariably 10 in number.

Description.—The centrodorsal is a small thin disk bearing marginal cirri in a single more or less irregular row.

The cirri are X–XXV (usually XV–XX), 17–24 (usually about 20). The first segment is very short, the second is more than twice as broad as long, and those following slowly increase in length to the sixth-eighth, which are from half again as broad as long to nearly as long as broad, then slowly decrease so that the outer are twice as broad as long, the few terminal lengthening again so that the penultimate, which is smaller than those preceding, is about as long as broad. The opposing spine is conical, very small, and median to subterminal in position. The terminal claw is markedly longer than the penultimate segment, slender in the distal two-thirds, and more strongly curved proximally than distally.

The row of cirri on the centrodorsal may be more less deficient, half of the circumference being sometimes without cirri.

The radials are usually entirely concealed, but a small portion of their distal lateral angles may be visible interradially. The IBr_1 are exceedingly short, from six to eight or more times as broad as long, and are in close contact laterally. They are united to the IBr_2 (axillaries) by syzygy, the line of union being perfectly straight. The IBr_2 are nearly or quite four times as broad as long, broadly triangular, with the lateral angles more or less sharp or slightly truncated and forming short sides which are usually separated by a narrow V-shaped slit.

The 10 arms are usually about 150 mm. long and are more or less flattened dorsally. They are narrow at the base and increase rather rapidly in width to the tenth or twelfth brachial, from which point they very slowly taper distally. A low, narrow, rounded keel, becoming conspicuous on the eighth brachial, often runs the entire length of the arms, though it is as often absent. The first brachial is very short and bandlike, from six to eight or more times as broad as long, with the proximal and distal edges straight and parallel; it is united to the second by syzygy. The second brachial (epizygal of the first syzygial pair) is low, wedge-shaped, and runs almost to a point interiorly. It is about three times as broad as the greater (outer) length. The third and fourth brachials form an approximately oblong syzygial pair which is about three times as broad as long. The fifth brachial is approximately oblong, slightly longer and broader than the syzygial pair preceding. The sixth brachial is of about the same size as the fifth, but is distinctly wedge-shaped. The following brachials have more and more oblique edges and after the tenth are triangular, somewhat more than twice as broad as long, with the distal edges at right angles to the longitudinal axis of the arm on the side away from the pinnule, but on the pinnule side running outward and forward at an angle of about 30° with the longitudinal axis to a point distal to the pinnule base. In the terminal portion of the arms the brachials increase slightly in length, becoming short wedge-shaped.

Syzygies occur between brachials 1 + 2, 3 + 4, from 11 + 12 to 14 + 15, and distally at intervals of from 4 to 11, most commonly 5 or 6, muscular articulations.

P_1 and P_a are very long and may reach 25 mm. in length. They are composed of about 60 segments, all of which are much broader than long. The segments in the distal half bear teeth. P_2 and P_b are shorter with fewer and smaller segments, but also bear a comb. P_3 and P_c are much smaller and shorter than P_2 and P_b with much shorter segments, all of which are much broader than long. The segments are much produced dorsally, so that the dorsal profile is strongly and roundedly serrate. The succeeding pinnules increase in length and stoutness. The component segments are much broader than long and those beyond the second are sharply keeled and more or less produced dorsally. In the extreme terminal portion of the arms the pinnules become slender and are composed of about 20 segments, which beyond the second are longer than broad. The second and third segments of P_2 and P_b usually possess a more or less strongly produced carinate process, which makes them appear much larger and broader than the segments succeeding. On P_3 and P_c and the pinnules following all of the segments bear more or less similar carinate processes, so that usually the second and third are not distinguished.

The disk is from 15 to 25 mm. in diameter. It is usually more or less extensively beset with plates and nodules, and is often completely covered with thin scalelike plates which on and in the immediate vicinity of the anal tube bear fairly regular globular nodules. The mouth is radial.

Notes.—In Müller's redescription of Lamarck's *Comatula solaris* based on an examination made for him by Troschel he gave the cirri as XX, 30. The radials are concealed. The 10 arms are about 160 mm. long. The intersyzygial interval is 4 or 5 muscular articulations. The epizygals of the syzygial pairs are extraordinarily short. The pinnules decrease only slightly in length from the oral outward, all of them being long. The pinnules are stout, 4-angled (that is, sharply carinate), and because of the production of the segments have a serrate profile.

Carpenter said that the number of cirrus segments as given, 30, is evidently a misprint for 20. But I can not believe that this is explained so easily. The number of cirrus segments, plus the fact that the pinnules are described as decreasing in length only slightly from the calyx outward, suggest that Troschel's notes were actually drawn up from a specimen of *Comatulella brachiolata* which in some way he mistook for the type of Lamarck's *Comatula solaris.*

Müller described *Actinometra imperialis* as having the centrodorsal a flat pentagonal disk which is somewhat concave centrally. The cirri are arranged in a single marginal row. Carpenter, who subsequently examined the type at Vienna, found that the centrodorsal has lost all trace of the cirrus sockets on one side and is almost reduced to a level with the radials.

The cirri are XIV, 20, the segments being as long as broad. The central segments of the younger cirri are longer than broad. The cirri are stout at the base, but decrease in stoutness and then remain of the same width.

The radials are very short. The IBr series are very short, and the two elements appear to be united with each other by suture.

The first brachial element seems to be a syzygial pair.

P_1 is on the epizygal of the first syzygial pair. The next 2 brachials (the third and fourth) are united by syzygy. Beyond this point the intersyzygial interval is from 3 to 6 muscular articulations.

The 10 arms are said by Müller to be 325 mm. in length. The brachials are dorsally flattened. The bases of the arms are narrower than the portion immediately following.

P_1 is the largest pinnule. P_2 is also large, though smaller than P_1. P_3 is very small, and the following pinnules increase in length. On P_2 the lowest segments are set off from the others by being broadened. The segments of the pinnules are laterally compressed, broader than long, and have a sharp edge behind.

The disk is beset with calcareous concretions, short flowerlike nodules with from 3 to 5 foliaceous plates.

The color, dry, is orange.

In the following terms Dr. P. H. Carpenter described a specimen from Australia which he found in the Hamburg Museum bearing Lütken's manuscript name *Actinometra robusta:*

The centrodorsal is a low flattened disk 7 mm. in diameter, bearing a single or partially double row of cirri.

The cirri are XX–XXV, about 23. The first 3 or 4 segments are broader than long and those following are about as long as broad, or a trifle longer than broad, decreasing slightly toward the end. The penultimate has a small opposing spine.

The radials are visible. The IBr_1 are short, trapezoidal, closely united laterally, and united by syzygy at their wider distal edges to the triangular IBr_2 (axillaries), which are twice their length.

The 10 arms are probably about 125 mm. long; they are rather more than 3 mm. wide at the fifth brachial, but increase to 5 mm. by the twelfth, remaining uniform for a short distance and then tapering to the ends. The arms consist of about 200 brachials.

The first 2 brachials are united by syzygy, this syzygial pair being twice as broad as its outer length, which is slightly the longer, though the hypozygal (first brachial) is longer on the inner side, which is very closely united to its fellow. The epizygal is acutely triangular, with curved sides, half as long as broad. The second syzygial pair (composed of brachials 3+4) is roughly oblong, with a somewhat raised forward projection from the inner part of its distal edge. The fifth brachial has a corresponding elevation at the inner side of its proximal edge so as to give a somewhat tubercular appearance to the line of junction. The same feature is visible on the outer part of the line of junction between the nearly oblong fifth and sixth brachials, and recurs alternately on opposite sides of the arm for a few brachials further. As the brachials become flatter and more triangular, with curved edges, it gradually disappears. These brachials are rather more than half as long as broad, with a very faint slightly raised median line, and retain the triangular shape and the curved edges as far as the one hundred and sixtieth, narrowing and becoming blunter at the extreme ends of the arms.

Syzygies occur between brachials 1+2, 3+4, and 11+12, then at intervals of from 4 to 7, usually 5 or 6, muscular articulations. The hypozygals of syzygial pairs are very short.

P_1 and P_a are long, about 25 mm. in length, and moderately stout. They consist of about 60 segments, of which the first 3 or 4 are nearly square and those following are shorter and more oblong and gradually decrease in width, the outer edges of the last 30 bearing the strong lancet-shaped processes forming the terminal comb. P_2 and P_b are smaller with fewer segments, only the first 2 of which are about square, while they have no dorsal keels. They also have a well-marked terminal comb, but this appears to be wanting on P_3 and P_c, which are still smaller, with short and wide triangular basal segments. P_4 and P_d are as long as, or longer than, P_3 and P_c but stouter, with broader and more massive segments. The following pinnules increase in both length and stoutness, and consist of about 30 segments, the first half of which are about twice as broad (2 mm.) as long, with sharpened dorsal edges which are sometimes produced into slight keels. The largest pinnules are those between the tenth and twenty-fifth brachials, and a little further on they become more slender with squarer segments, the terminal pinnules having somewhat elongated segments.

The disk is 25 mm. in diameter, without any trace of calcareous deposits.

The color of the specimen (dry) is black.

The preceding description was partly based on a second dry specimen also bearing the manuscript name *robusta* in the collection of Dr. W. B. Carpenter.

Carpenter remarked that *robusta* has a considerable resemblence in general appearance to *solaris*, both having large arms composed of massive triangular brachials with curved edges, and stout pinnules composed of broad segments. The arm bases of *solaris*, however, are nearly or quite smooth and have little tendency to alternate tubercular elevations, such as are visible in *robusta*. In the latter, too, the width of the arms increases more distinctly in the first few brachials than in *solaris*, while the second and third pairs of pinnules have no expanded keels on the lower segments, such as appear in *solaris*, and the cirri are larger and more numerous.

Carpenter thus described a specimen from Hong Kong in the Hamburg Museum. The centrodorsal is a thin pentagonal disk bearing 2 cirri at each angle.

The cirri are X, 22–23; the first segment is very short and those following increase in length to the fourth, which is about as long as broad, the remainder being tolerably equal and longer than broad. The penultimate bears a well-marked opposing spine.

The radials are visible. The IBr_1 are trapezoidal, closely united laterally and broadest along the distal edge where they are united by syzygy to the IBr_2 (axillaries), which are triangular and more than twice their length.

The 10 arms are about 150 mm. in length and are composed of 130+brachials. They increase in width only slightly from the base. The first 2 brachials are united by syzygy. The first brachials are closely united interiorly and are shorter interiorly than exteriorly, the exterior length being two-thirds the width. The next 5 or 6 brachials are more oblong with slightly developed articular tubercles. The following brachials are triangular with convex proximal and concave distal edges, twice as broad (nearly 5 mm.) as long, becoming more quadrate toward the arm ends. The lower and middle parts of the arms have a faint slightly raised mediodorsal line.

Syzygies occur between brachials 1+2, 3+4, about 12+13, and distally at intervals of from 4 to 6 muscular articulations.

P_1 and P_a are both about 20 mm. long and consist of about 40 segments, of which the lowest 5 or 6 are wide and stout, with prominent dorsal edges but no distinct keels. The next 2 pinnules on either side are of decreasing length and stoutness; they have the second and third segments wide, with strong and expanded dorsal keels. The fourth pair, though somewhat shorter than the third, are considerably stouter, with broader and more massive segments and large gonads. The following pinnules are somewhat longer and tolerably equal, decreasing again after about the twenty-fifth brachial, but remaining stiff throughout and never becoming especially slender. The lower and middle segments of these pinnules until far out on the arms are very broad, reaching nearly 2 mm., and have sharpened dorsal edges. The middle segments of the pinnules do not become elongated until about the eightieth brachial. The terminal comb is found only on P_1, P_2, and P_3 and the corresponding inner pinnules.

The disk is 15 mm. in diameter, naked, with a radial mouth.

The color in alcohol is brownish white, each arm with a narrow light mediodorsal band flanked on either side by a broad reddish-brown stripe.

A specimen from Singapore in the Hamburg Museum is similar to the one just described from Hong Kong, but slightly more slender. There are 21 cirrus segments. There is a similar specimen from Singapore in the British Museum.

These and the individual from Hong Kong resemble the slender form of *Comatula pectinata*, except for the much greater size and much larger number of cirrus segments. They have not the broadly expanded arms and stout cirri of the Australian individuals (the so-called *robusta*), nor are the arms so flat dorsally. Both are in color light brown with a fine mediodorsal line of white and white borders to the arms. The Hong Kong specimen has III cirri and the one from Singapore II and 2 stumps. In both the centrodorsal is undergoing reduction.

The 3 specimens from Billiton in the British Museum are all of the slender-armed type and resemble those from Hong Kong and Singapore noticed above.

In the specimen from the China Sea recorded by Hartlaub the cirri are about XIV, 12; but only 5 of them are preserved. It is possible that this is in reality a specimen of *C. pectinata*.

The specimen from East Wallaby Island has the arms, which are remarkably stout, about 125 mm. in length and about 7 mm. broad near the base. It is almost black, but has a longitudinal light stripe on the dorsal side of each of the arms.

The specimen from Long Island, Abrolhos, is not quite so large as the preceding. It has the cirri XIII, 18. It shows no trace of the light mediodorsal stripe on the arms.

The example from the coast of Western Australia is of the broad-armed (*robusta*) type and is uniform in color, almost black.

Professor Döderlein's specimens from Thursday Island have the cirri XIII–XXI, 15–19. On an arm 95 mm. long, P_1 is 20 mm. long. On an arm 60 mm. long, P_1 is only 11 mm. long. The pinnules resemble those of *C. pectinata*, but the combs are much more developed. The comb is strongly developed in the outer half of P_1, and on P_2 it sometimes equals half the entire length of the pinnule. There are traces of a comb on the following pinnules also. P_2 bears a high keel on the second and third segments, though this is often almost entirely lacking. All of the arms are grooved. The disk is warty and granulated. The color varies from dark brown to dark violet. In some specimens the dorsal side is whitish. Regenerated portions of the arms in otherwise dark specimens are light. Döderlein says that these specimens of *C. solaris* differ from *C. pectinata* in the granulated disk, in the grooving of all the arms, in the large comb on the first 2 pinnules, and in the larger number of cirri, which have a somewhat greater number of segments.

Carpenter said that the calyx of the form from between Albany Island and Somerset, which he originally called *strota*, except for the almost entire absence of a basal star, is not greatly different from that of the individual from Singapore which he figured in 1879; but it is very much smaller than the calyx of the form which he originally called *robusta* which reaches 7 mm. in diameter, while 5 mm. is the maximum in the *Challenger* specimens. None of these last show any trace of the curious diverticulum of the axial canal into the substance of the radials which occurs in that variety. Several of the *Challenger* specimens are more or less immature. The smallest are noteworthy for the great relative length of the brachials as compared with those of the adults.

Two specimens collected by the *Alert* in Prince of Wales Channel were described by Bell as having the cirri XII, 18+. The more proximal brachials in the smaller individual are more "knobby" than the corresponding brachials in the larger. In both the arms are broadest at a little distance from the disk. The keels on the basal segments of P_2 are well marked in the smaller specimen, but in neither are there any very prominent keels on the basal segments of P_3. The arms of the larger example are about 120 mm. long and those of the smaller about 85 mm. In the larger P_1 is about 20 mm. long, and the cirri are about 16 mm. long. Both specimens are white, without any mediodorsal line; dark spots or marks are prominently developed on the pinnules.

Bell described his *Actinometra albonotata* from Albany Island as having 20–25 cirrus segments, and the keels on the basal segments of P_2 less prominent than those in *solaris*. But he said that the general facies of this form is distinctly that of *solaris*, with the exception of the rather remarkable coloration, which has led to the proposal of a distinctive name. He noted, however, that when a careful comparison is made between the pattern of this coloration and that of the 2 specimens from the Prince of Wales Channel which he unhesitatingly referred to *solaris* it is seen that there is really a striking resemblance between the two. He remarked that this leads to the reflection that great circumspection is to be exercised whensoever we are tempted to make use of differences in color as a distinguishing mark. He recalled that he had already stated that there are black patches or spots on the pinnules of the specimens described from the Prince of Wales Channel; in the one at hand from Albany Island these spots, having greatly increased in number and become more extensive than the white, have caused the white ground to assume the appearance of spots on a dark ground. The extreme limit of the species, according to Bell, seems to be reached by this individual, and as the cirri are more numerous than usual and the basal segments of P_2 are less strongly keeled, he proposed to speak of it as *Actinometra solaris* var. *albonotata*.

On the theory that the keel is constantly present on the basal segments of P_2 in *solaris* and that is it never found in *robusta*, Bell described an intermediate form from Albany Island in which, according to him, the keels are never so well developed as in *solaris*, and never so slightly as in *robusta*, although he recognized the fact that there are considerable differences in the extent of development of the keels, not only within the limits of the species but even in the same individual. He gave the following as the more characteristic features of the species. The cirri are XVIII, 18–20. P_1 is not especially long and is composed of rather more than 40 segments. The basal segments of P_2 have a not conspicuous keel which varies in the extent to which it is developed. A specimen with an arm length of 120 mm. has the cirri 15.5 mm. long and P_1 20 mm. long. The arms are 3 mm. broad at the widest place, which is a slight distance from the disk. The faint white line which is so often seen along the middle of the dorsal surface of the arms is to be seen in some specimens, and in some cases the black spots on the pinnules may be observed.

Professor Bell noted that in a large specimen from Port Curtis which he identified as *robusta* the knobbing of the lower brachials is very prominent.

Carpenter remarked that the specimen which he described from Hong Kong represents one of the many variations in the type of *Comatula solaris*.

He said that Lamarck's example in the Paris Museum and the large specimen at Vienna which served Müller as the type of his *Actinometra imperialis*, both of which he personally examined, agree in their general characters.

He regarded as the peculiar feature of the species the character of the lower pinnules. The first pair of pinnules are composed of numerous stout segments the lowest of which are stouter than, but not otherwise different from, their successors. But in the next pair of pinnules some of the lower segments have their dorsal edges produced into well-marked keels. In Lamarck's type these keels occur on the second, third, and fourth segments of the pinnules on the fourth and fifth brachials (P_a and P_2), while in the Vienna specimen (the type of *imperialis*) there is little or no keel on the fourth segment of the fourth pinnule, and in the specimen from Hong Kong the third pair of pinnules have keels on their second and third segments. He did not regard this variation as of any importance, though he thought that the entire absence of a keel on the 2 lowest pinnules (P_1 and P_a) is a good distinctive character of the type.

He noted that other points in which the types of *solaris* and *imperialis* and the specimen from Hong Kong all agree are the unusual size of the lower brachials, which may be as much as 5 mm. wide, and also the shape of the segments composing the pinnules of the sixth and following pairs. These are best seen when the pinnules are dried, as they are then less concealed by perisome. The lowest segments are more than twice as broad as long, and although this disproportion gradually decreases it is only quite at the extreme end of the pinnule that the segments become anything like square. This peculiarity is, of course, most marked in the lower pinnules, but it is not until well on into the second third of the arm that the middle segments of the pinnules begin to be at all longer than broad.

Carpenter therefore considered that what may be called the special marks of *solaris* are: Cirri X–XV, 20–24; brachials and pinnule segments very broad; the presence of expanded keels on the lower segments of the pinnules of the second pair and some of the following pinnules, but the basal segments of the pinnules of the first pair are not keeled.

Carpenter noted that in the specimens from Cape York the plating of the disk reaches the greatest development found in the comasterids. The whole of the large anal area is covered with more or less scaly plates which become stouter and more granular in the neighborhood of the subcentral anal tube. The sides of the deep ambulacral grooves are bounded and supported by numerous smaller plates without any definite arrangement. The plates immediately adjacent to the grooves are extensively pierced by the water pores. Much of this armature extends beneath the water vessels and corresponds to what Müller called the subambulacral plates in *Cenocrinus.* The plating ceases just within the circumference of the disk, so that the perisome of the arms and pinnules is perfectly bare.

The simple calcareous spicules and thin networks which occur in the less heavily plated disks are especially abundant in the visceral layer of the peritoneum. This is well illustrated by this species in which there is but little connection between this visceral layer and the parietal layer lining the interior of the cup so that the entire visceral mass is readily detached from the calyx.

Abnormal specimen.—Under the name of *Actinometra strota* Dr. P. H. Carpenter mentioned a specimen dredged by the *Challenger* at Cape York in which one of the second brachials on the right posterior postradial series bears two fully developed pinnules instead of the arm and its own proper pinnule, so that it has the appearance of an axillary. There is no disk ambulacrum corresponding to this undeveloped arm.[5]

Localities.—Singapore [P. H. Carpenter, 1879, 1888; A. H. Clark, 1911, 1912, 1913] (2. B. M.; H. M.).

Billiton [P. H. Carpenter, 1888; A. H. Clark, 1913] (3, B. M.).

China Sea [Hartlaub, 1891].

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[5] See vol. 1, pt. 2, pl. 24, fig. 1149.

Hong Kong [P. H. Carpenter, 1882, 1888; A. H. Clark, 1911, 1912] (1, H. M.). Same [Hartlaub, 1912].

East Wallaby Island, Abrolhos, Western Australia [H. L. Clark, 1923].

Long Island, Abrolhos [H. L. Clark, 1923].

Holothuria Bank, northwestern Australia [A. H. Clark, 1911, 1913] (1, B. M.).

Coast of Western Australia [H. L. Clark, 1914] (1, W. A. M.).

Thursday Island, Torres Straits [Döderlein, 1898].

Challenger station 187; off Booby Island, Torres Straits (lat. 10° 36′ S., long. 141° 55′ E.); 10.9 meters; coral mud; September 9, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (7, M. C. Z., 209; B. M.).

Alert; Prince of Wales Channel, Torres Straits; 9.1–12.8 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (2, B. M.).

Alert; Prince of Wales Channel [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (6, B. M.).

Alert; Torres Straits; 18.2 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (4, B. M.).

Alert; Albany Island; 5.4–7.3 meters; mud [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (7, B. M.).

Albany Passage; 5.4–16.4 meters (1, U.S.N.M., 34931).

Challenger station 186; channel between Albany Island and Somerset, Cape York; 14.6–21.9 meters [P. H. Carpenter, 1888; A. H. Clark, 1911]; also given simply as Cape York [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911, 1913] (5, B. M.).

Cape York; Prof. J. Beete Jukes; H. M. S. *Fly*, 1843–1847 [P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (7, B. M.).

Alert; Fitzroy Island, Queensland [A. H. Clark, 1911, 1913] (1, B. M.).

Masthead Island (Capricorn Islands) lagoon [A. H. Clark, 1911] (1, Austr. M.).

Rockhampton, Queensland [A. H. Clark, 1912] (1, H. M.).

Alert; Port Denison, Queensland [A. H. Clark, 1911, 1913] (1, B. M.).

Port Denison (1, U.S.N.M., 17878). Pl. 33, fig. 99.

Alert; Port Molle [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Port Molle [Bell, 1885; A. H. Clark, 1911] (1, Austr. M.). Same (1, U.S.N.M., 35708).

Port Molle; 21.9 meters [A. H. Clark, 1911]. Same, 25.5 meters [A. H. Clark, 1911] (3, U.S.N.M., 34937; Austr. M.).

Alert; Port Curtis; 9.1–20.1 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

Australian Seas; Péron and Lesueur, 1803 [Lamarck, 1816; P. H. Carpenter, 1879, 1882, 1888; A. H. Clark, 1911] (6, P. M.).

Australia [P. H. Carpenter, 1882, 1888; A. H. Clark, 1912] (1, H. M.). Same [Bell, 1885]. Same [A. H. Clark, 1909] (1, C. M.). Same (2, U.S.N.M., 36152, 36159).

?Society Islands; Sir Joseph Banks [Owen, 1840].

No locality (but undoubtedly the Torres Straits region); Prof. J. Beete Jukes; H. M. S. *Fly*, 1843–1847 [A. H. Clark, 1913] (1, B. M.).

No locality [J. Müller, 1841]. Same [A. H. Clark, 1911] (10, Austr. M.). Same [A. H. Clark, 1913] (1, B. M.). Same [Gislén, 1924].

Erroneous localities.—Zanzibar [von Martens, 1869] (= *Tropiometra carinata*).

Indies [J. Müller, 1843, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1888] (error for Australian Seas).

Near Bohol, Philippines [von Graff, 1877, 1884] (= *Comatula pectinata*). Philippine Islands [A. H. Clark, 1911] is based on this record.

Moluccas [von Graff, 1887] (= *Comatula pectinata*).

Dundas Strait [Bell, 1884] (= *Comatula pectinata* + *C. purpurea*).

Alert station 144; probably Thursday Island [Bell, 1884] (= *Comatula pectinata*).

Thursday Island [Bell, 1884] (= *Comatula pectinata*).

Arafura Sea [Bell, 1884] (= *Comatula pectinata*).

Warrior Reef [Bell, 1884] (= *Comatula pectinata*).

Geographical range.—From Hong Kong and Singapore southward to tropical Australia, reaching the Abrolhos Islands (lat. 28° 40′ S.) on the west coast and Port Curtis (lat. 24° S.) on the east; possibly eastward to the Society Islands.

Bathymetrical range.—Littoral and sublittoral, extending from the shore line down to 21.9 meters; the average of 8 records is 13.3 meters.

Remarks.—In view of the quite different aspect presented by the light-colored slender-armed individuals from the northern portion of the range, it might be advisable to differentiate these as *Comatula solaris gracilior*, the range of which would be from Hong Kong and the China Sea to Singapore and Billiton. This would restrict the range of typical *Comatula solaris solaris* to the Australian coasts.

History.—This species was originally described by Lamarck in 1816 under the name of *Comatula solaris* from specimens brought from Australia by Péron and Lesueur in 1803.

In 1830 Sir Richard Owen mentioned a specimen in the museum of the Royal College of Surgeons identified by W. E. Leach as *Comatula solaris* which was said to have been brought from the Society Islands by Sir Joseph Banks. We know practically nothing of the crinoids of the Society Islands, and it is not unlikely that some form of this species occurs there. But this specimen, which was exhibited to show the ovaries and ova, has disappeared and no comasterids have since been recorded from the region.

In 1841 Johannes Müller described in great detail under the name of *Actinometra imperialis* a magnificent specimen without locality which he had examined in the Vienna Museum.

In 1843 Müller published a redescription, under the name of *Alecto solaris*, of Lamarck's types in the Paris Museum based upon notes which had been taken for him by Troschel. The locality was given as "Indien," although the specimens were correctly stated to have been collected by Péron.

Müller's detailed description of this species under the name *Comatula* (*Actinometra*) *solaris* published in 1849 was essentially the same as his description of *Actinometra imperialis* published in 1841, but it was broadened so as to include some additional specimens which he had been able to examine and which he believed to be conspecific with it. He had personally studied the types of *Comatula solaris* at Paris and had found that they represent the form which he had described as *imperialis*. He was inclined to believe that the Linnean *Asterias pectinata*, which he included in the synonymy with a query, is simply a color variety of *solaris*. His *Alecto purpurea*, described in 1843, he considered as a synonym of *solaris*, remarking that it differs only in the number of the radials (that is, the radials and the elements of the IBr series), of which 2, united by syzygy, are visible; this difference he regarded as perhaps due to age, the type of *purpurea* representing the young form. Repeating the error of 1843, he gave the habitat as "Indien." He mentioned having examined specimens in the museums at Paris, Vienna, and Leyden.

Dujardin and Hupé (1862) divided the recent comatulids among the genera *Comatula*, *Actinometra*, and *Comaster*. They took their description of *Comatula solaris* directly from the description published by Müller in 1843, giving as the locality "mers de l'Inde." They also republished Müller's description of *Actinometra imperialis*, overlooking the fact that Müller himself regarded *solaris* and *imperialis* as synonymous.

In 1879 Dr. P. H. Carpenter published extensive notes on the structure, particularly of the skeleton, of *solaris* and of another form which he called *Actinometra robusta*. This name he had found associated with specimens purchased from the Godeffroy Co. at Hamburg which had been identified by Dr. Christian Lütken; but no description of the type ever had been published. He does nor mention the place of origin of the specimens dissected, but the figured specimen of *Actinometra solaris* was from Singapore, and the specimen of *Actinometra robusta* was one in his father's collection which had been acquired from the Godeffroy Co. and which had come from Australia. In the preparation of this memoir he had been able to examine the *Challenger* collection, the large collection made by Prof. Carl Semper in the Philippines, and the collection of the British Museum. In the autumn of 1876 he had visited Paris and there examined the material previously studied by Lamarck and by Müller. In Semper's collection from Bohol, Philippine Islands, he had found a number of specimens which he had identified as *Actinometra solaris*, and he had sent the myzostomes from these and from some similar specimens from the Moluccas to Prof. Ludwig von Graff, giving *Actinometra solaris* as the name of the host. In this memoir the Philippine specimens are mentioned under the name of *Actinometra pectinata*, but with no indication that they are the same ones mentioned by von Graff in 1877 as *Actinometra solaris*.

In a preliminary notice of the *Challenger* collection published in 1879 Carpenter noted the presence of *Actinometra solaris*, and in another paper published in the same year he gave various notes on its anatomical structure.

In a popular account of the comatulids published in 1880 Carpenter figured an unplated disk of *Actinometra solaris* drawn from a specimen in the *Challenger* collection, but the species is not mentioned in the text, nor is the origin of the specimen given.

In his preliminary account of the comatulids collected by the *Blake* Carpenter remarked that the species of *Actinometra* in which he had found the plating of the disk to reach its greatest development in a large one common at Cape York, which is probably identical with *Actinometra robusta* Lütken, MS. He also noted that the

Challenger in cruising from Cape York through the Banda and Arafura Seas to the Philippines and thence southward to the Admiralty Islands dredged three 10-armed species of comatulids of the *solaris* type. These he does not mention by name; two of them are *solaris* itself, while the third is *Comatula pectinata*.

In another paper published in 1881 he gave a synonymy of *Actinometra solaris* which he considered as including the *Actinometra imperialis* of Müller and the *Comatula* (*Actinometra?*) *hamata* of Kuhl and van Hasselt. He excluded, however, *Asterias pectinata* Linné and *Alecto purpurea* J. Müller, both of which species had been treated as probably synonymous with *solaris* by Müller in 1849. He recorded a single specimen in the Leyden Museum which appeared to him to be the type of *hamata*. He remarked that this is a very variable species and this specimen does not appear to be sufficiently distinct from Lamarck's original specimen in the Paris Museum to justify the establishment of another species.

In his account of the comatulids of the Hamburg Museum published in 1882 Carpenter, under the name *Actinometra solaris*, described in great detail a slender-armed specimen from Hong Kong which he said represents one of many variations on the type of *Comatula solaris*. He gave a history of the species and notes on the type specimens of *solaris* which he had examined at Paris, and of *imperialis* which he had studied at Vienna. He remarked that there are several other species of smaller size and with fewer segments in the cirri which are closely related to this type for which it is difficult as yet to determine the range of variation. Among these he mentioned the specimens from Bohol collected by Professor Semper and formerly referred by him to *solaris*. Under the name of *Actinometra robusta* he described in great detail a dry specimen from Australia which had been named by Lütken. At the same time he recorded another in the collection of his father. Both had been purchased from the Godeffroy Co. at Hamburg.

Prof. F. Jeffrey Bell in 1882 published a so-called specific formula for *Actinometra solaris* and for another species which he called *Actinometra albonotata*. The latter had been collected by the *Alert* in northeastern Australia, although this fact is not stated.

Early in 1883 Carpenter published a revised formula for *Actinometra solaris* and also a formula for *Actinometra robusta*.

In the report upon the zoological collections brought together by H. M. S. *Alert* which was published in 1884 Professor Bell recorded this species under various names and also confused with it other forms. In 1910 I examined the *Alert* material in the British Museum and found the following correspondence between his records and the specimens upon which they were based:

Antedon milberti, Port Denison	includes 1 specimen of *C. solaris*.
Actinometra solaris, Prince of Wales Channel	=*solaris* (2)+*pectinata* (1).
Warrior Reef	=*pectinata* (1).
Port Curtis	=*pectinata* (1).
Torres Straits	=*solaris* (4)+*pectinata* (1).
Arafura Sea	=*pectinata* (1).
Dundas Strait	=*purpurea* (2)+*pectinata* (1).
Thursday Island	=*pectinata* (3).
Albany Island	=*solaris* (1).
Actinometra solaris var. *albonotata*, Albany Island	=*solaris* (1).
Actinometra intermedia, Albany Island	=*solaris* (6).

Actinometra robusta, Probably Thursday Island = *pectinata* (4).
Port Curtis = *solaris* (1).
Actinometra strota, Port Molle = *solaris* (1).

In the *Challenger* report on the stalked crinoids (1884) Carpenter mentioned this species as *Actinometra robusta*, *Actinometra solaris*, and *Actinometra strota*. Under *Actinometra solaris* he cited the keeled lower segments of the earlier pinnules and the radial position of the mouth. Of *Actinometra robusta* he said that it and *Heliometra glacialis* are almost the only living comatulids with arm bases anything like as massive as those of the fossil species. Under *Actinometra strota*, which he said is common at Cape York, he described an abnormal specimen, mentioned the looseness of the attachment of the visceral mass and the tolerably equal and symmetrical arrangement of the ambulacral grooves on the disk, the plating of the disk and the visceral layer of the peritoneum, the pigment, as determined by Moseley, and the parasitic isopod (*Anilocra*) sometimes found in the anal tube.

In 1885 Professor Bell recorded some additional specimens from Australia, and in 1886 Dr. P. H. Carpenter discussed the cirri in relation to those of other comatulids.

In the *Challenger* report on the comatulids (1888) Carpenter published a detailed account of this species, repeating much of the information on its structure and anatomy which he had previously given, but adding very little that is new. He included as synonyms of *solaris* the subsequently described *imperialis*, *hamata*, *robusta*, *albonotata*, *intermedia*, and *strota*, the last a name which he had tentatively given to the *Challenger* specimens from Cape York and which had been published in his report upon the stalked crinoids (1884) in connection with structural and anatomical notes, by Bell (1884), and also by von Graff (1885), though never in association with a formal description. It had also been given by von Graff (1884) as *strata*, and is so printed once in the present report. He gave a detailed description of the species, mentioned a specimen from Port Molle collected by the *Alert* in which the centrodorsal is reduced to a pentagonal plate without cirri (see under *Comatula cratera*), and remarked that in the type of *imperialis* the centrodorsal has lost all trace of cirri on one side. He transferred the localities Bohol and the Moluccas given by von Graff to *pectinata*, together with a number of those given by Bell; but he gave no references to von Graff's papers. The only new locality he gave for *solaris* was Billiton, from which island he had examined some in the British Museum. Among the localities he gives "Indien (Mus. Wien)," which evidently refers to the type specimen of *imperialis*. But this specimen was without locality. The locality "Indien" was given by Müller in mistake for "Neuholland" in 1843 and refers to the Lamarckian types of *solaris* in the Paris Museum.

In 1891 Hartlaub recorded a specimen in the Göttingen Museum from the China Sea, and in 1898 Döderlein recorded this species from Thursday Island.

In 1909 I mentioned a dry example from Australia in the Copenhagen Museum which had been determined by Lütken as *Antedon* (*Actinometra*) *robustum*.

In 1911 I published a detailed account of this species, including the synonymy and all previous records, and listed additional specimens from Port Molle and Masthead Island, and others without locality. In another paper I discussed its distribution in detail. In a paper on the crinoids in the Paris Museum I noted having examined the original Lamarckian types in Paris, and in a paper on the crinoids of Africa I suggested that the *Comatula solaris* recorded by von Martens from Zanzibar was probably *Tropiometra carinata.*

In 1912 Hartlaub recorded a fragmentary specimen of *Actinometra echinoptera* var. *meridionalis* from Hong Kong. Most likely it was in reality this species, though it may have been *C. pectinata;* it certainly could not have been any form of *Comactinia*. In 1912 I gave a detailed account of this species in connection with a survey of the crinoids of the Indian Ocean, and in a paper on the crinoids of the Hamburg Museum gave notes on a specimen from Singapore, recorded one from Rockhampton, Queensland, and mentioned the two which had been described in detail by Carpenter in 1882 as *solaris* and *robusta.*

In 1913 I listed all the specimens in the collection of the British Museum, redetermining the material from the *Alert* dredgings described by Professor Bell in 1884.

In 1914 Dr. H. L. Clark mentioned a specimen from the coast of Western Australia.

In the report on the unstalked crinoids collected by the *Siboga* (1918) I published a key to the species of *Comatula* in which a distinction was made between the stout-armed type of *solaris* and the slender-armed type which was designated as variety *hamata.*

In 1921 Dr. H. L. Clark discussed the distribution of this species in great detail, and in 1923 he recorded additional specimens from localities in the Abrolhos Islands, Western Australia.

In 1924 Dr. Torsten Gislén brought out some additional information in regard to the skeletal structure of this species.

COMATULA PECTINATA (Linné)

Plate 20, Figure 49; Plate 33, Figure 100; Plate 34, Figure 101; Plate 35, Figure 102; Plate 36, Figure 103; Plate 37, Figure 104; Plate 38, Figures 105–107

[See also vol. 1, pt. 1, fig. 36 (synarthry), p. 75; fig. 45 (grooved and ungrooved arms), p. 79; fig. 47 (arm tip), p. 81; fig. 58 (comb), p. 83; fig. 150 (centrodorsal), p. 220; figs. 236, 240 (ventral view of centrodorsal), p. 249; fig. 327 (cirrus), p. 281; fig. 422 (basal ray), p. 321; figs. 445, 446 (radials), p. 351; fig. 454 (dorsal view of radial pentagon), p. 355; pt. 2, figs. 17, 18 (centrodorsal and radials), p. 15; fig. 163 (dorsal view), p. 86; fig. 184 (dorsal view), p. 100; fig. 185 (dorsal view), p. 102; figs. 395, 396 (pinnule tip), p. 245; figs. 398–405 (pinnule tips), p. 250; figs. 689, 690 (disk), p. 341; pl. 24, fig. 1149 (disk); pl. 47, fig. 1324 (central portion, after removal of visceral mass)]

Asterias pectinata Linné, Syst. Nat., ed. 10, vol. 1, 1758, p. 663 (description; Indian Seas; type specimen, but none of the references cited); ed. 12, vol. 1, 1767, p. 1101.—A. J. Retzius, K. svensk. Vetensk. Akad. Handl., År 1783, vol. 4, p. 241 (redescription of the type).—Gmelin, Syst. Nat., vol. 1, pt. 6, 1788, p. 3166 (part).—Latham and Davis, Faunula Indica, 1795, p. 32.—Bosc, Hist. nat. des vers, vol. 2, An X (1802), p. 114.—Gebauer, System. Verzeichniss d. Seesterne, Seeigel, etc., 1802, p. iv.—A. J. Retzius, Dissertatio sistens species cognitas asteriarum, Lund, 1805, p. 34.—Cuvier, Le règne animal, vol. 4, 1817, p. 12; Le règne animal, nouv. ed., vol. 3, 1830, p. 229.—Latreille, Cuvier's Animal Kingdom, vol. 4, 1831, p. 334.—J. Müller, Archiv f. Naturgesch., 1843, vol 1, p. 133 (redescribed from the Linnean type).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 2 (composite character of Linné's' species); p. 11 (of Retzius=*Actinometra pectinata*).—A. H.

Clark, Proc., U. S. Nat. Mus., vol. 34, 1908, p. 500 (history; identity); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 711 (distinct from *Alecto purpurea*); Crinoids of the Indian Ocean, 1912, p. 1 (history; identification of the elements of the Linnean composite); p. 2 (Linné in 1767 placed in the synonymy of this species *Stella marina polyactis* and *Luna marina altera* of Seba).

Asterias (*Euryale*) *pectinata* Oken, Lehrb. d. Naturgesch., 3 Thiel, 1815, p. 356.

Comatula (*Actinometra*) *solaris* var.? J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 249.

Comatula cumingii J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 255 (description; Malacca).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (can not place in *Antedon* or *Actinometra*).—A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 202 (compared with *C. pectinata*); Notes from the Leyden Mus., vol. 33, 1911, p. 177 (synonym of *C. pectinata*); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 746 (young of *C. pectinata*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 383 (=*Comatula pectinata*); Crinoids of the Indian Ocean, 1912, p. 30 (same).

Comatula barbata Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 203 (assigned by Müller to *Actinometra*).

Comatula pectinata Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 203 (assigned by Müller to *Actinometra*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (listed); vol. 35, 1908, p. 124 (listed); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 202 (*Albatross* stations 5139, 5142; also Philippine Is. without further data; compared with *C. cumingii*); p. 203 (arm structure); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 394 (*Albatross* station 5152); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 144 (arms compared with those of *C. micraster*); p. 173 (articulation between the elements of the IBr series a pseudosyzygy); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 124 (multibrachiate condition fortuitous); p. 148 (synonymy; includes *affinis* Lütken; Java; Singapore; description of specimens; brachial dimorphism and its significance; 16 per cent of the specimens have more than 10 arms); p. 193 (collected at Singapore by Svend Gad); Proc. Biol. Soc. Washington, vol. 23, 1910, p. 96 (relationship with *C. purpurea* here redescribed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 532 (*Albatross* stations 5276, 5358); p. 535 (shallow median groove on axillaries compared with that of *Comaster scitulus*); Notes from the Leyden Mus., vol. 33, 1911, p. 177 (synonymy; includes *C. cumingii*); Die Fauna Südwest Australiens, vol. 3, Lief. 13, 1911, p. 436 (obtained in Dundas Strait by the *Alert*); p. 437 (northwest Australia, 9 and 20–36 fathoms); p. 439 (East Indian species occurring south to Baudin I. and Port Jackson); p. 443 (range on east coast); p. 444 (range on west coast); p. 446 (summary of west Australian records); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 717 (known to Carpenter from Australia); p. 722 (occurs south to Port Jackson and Sydney); p. 723 (northwest Australia; Dundas Strait; Baudin I.; Shark Bay); p. 733 (in key); p. 744 (robust form of this species common throughout its range; annotated synonymy; characters; variation in the type of articulation in the IBr series; difference in length between the anterior and posterior arms; number of ungrooved arms; variation in the number of arms; Albany Passage; Port Jackson; descriptions of specimens; summary of additional Australian records; never more than 10 arms in the stout-armed form; *C. cumingii* in the young of this species); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 5 (detailed comparison with *C. solaris*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 383 (includes *C. cumingii*); p. 389 (Banka Strait; British North Borneo; Malacca; pseudosyzygy may or may not be present in the IBr series); Crinoids of the Indian Ocean, 1912, p. 17 (Australian specimens have their characters greatly accentuated over those from other regions); p. 21 (range closely parallels that of *Zygometra*); p. 30 (includes *C. cumingii* J. Müller); pp. 31, 35, 37, 39 (identity of previous records); p. 80 (synonymy; localities; descriptions of specimens; summary of previous records; remarks); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 10 (published references to specimens in the British Museum; localities represented; characters of the specimens); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of the distribution in Australia).—H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 101 (Mer, uncommon; Friday I.); Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 92 (occurs at Ceylon; from A. H. Clark, 1912).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916,

p. 233 (British North Borneo, No. 6374).—A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, pp. 271, 272, 273, 275 (listed).—GISLÉN, Kungl. svenska Vetenskap Handl., vol. 59, No. 4, 1919, p. 3 (discussion); p. 5 (Mjöberg's stations 1, 3, 5, 12); fig. 1, p. 13 (comb of P_1); pl. 1, fig. 1.—A. H. CLARK, Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 3, fig. 36 (grooved and ungrooved arms); pl. 8, fig. 44.—H. L. CLARK, The Echinoderm Fauna of Torres Strait, 1921, pp. 5–7 (history); p. 8 (secured by the Carnegie Exped.); p. 10 (found in all collections from Torres Strait); p. 14 (Mer; south of Friday I.; not common; color; range); pp. 192 and following (range); pl. 1, fig. 3; pl. 3, fig. 2 (both colored).—GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 65 (pinnules compared with those of *Catoptometra hartlaubi*).—H. L. CLARK, Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Abrolhos Is.); p. 233 (Long I.; First I.; characters; remarks).—GISLÉN, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 11 (posterior arms do not end in an axillary with 2 equal pinnules); p. 27 (9-armed specimen from Java); p. 41 (details of arms); p. 56 (biseriality); p. 76 (syzygies); figs. 1, 2, p. 13; fig. 20, p. 50; figs. 27–29, p. 52; fig. 46, p. 58; fig. 63, p. 75 (syzygial face).

Actinometra pectinata DUJARDIN and HUPÉ, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 210 (synonymy; description; notes on a specimen in the Rennes Mus.).—W. B. CARPENTER, Philos. Trans. Roy. Soc., vol. 156, 1866, p. 696 (*fimbriata* of Barrelier ranked with this species by Dujardin).—P. H. CARPENTER, Proc. Roy. Soc., vol. 28, 1879, p. 392; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position); p. 42 and following (structure and anatomy); p. 62 (believed to be a variety of *C. solaris*); pl. 3, fig. 1; pl. 5, figs. 5–9; pl. 8, figs. 5–8; Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 284 (synonymy; description; Cape York; between Albany I. and Somerset; other localities; discussion); pl. 53, figs. 15–22.—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 11 (collected by Brock at Amboina); p. 107 (Amboina; China Sea; Cooktown, Queensland; characters); p. 113 (in Göttingen Mus.).—BELL, Proc. Zool. Soc. London, 1894, p. 394 (northwest Australia, 20–36 fathoms).—KOEHLER, Mém. soc. zool. France, vol. 8, 1895, p. 422 (Sunda Is.; Biliton; notes).—DÖDERLEIN, Denkschr. d. medicin. -naturwiss. Gesellsch. Jena, ser. 8, vol. 5, 1898, p. 478 (Thursday I.).—PFEFFER, Abhandl. Senck. Naturforsch. Gesellsch., vol. 25, 1900, p. 85 (Ternate).—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1583 (listed).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, pp. 716, 718, 719, 720 (identity of Australian records); Crinoids of the Indian Ocean, 1912, pp. 35, 38, 39 (identity of previous records); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 77 (of Bell, 1884 = *C. purpurea;* B. M., MS. = *Comissia ignota, Comatula purpurea* and *C. pectinata*).—H. L. CLARK, The Echinoderm Fauna of Torres Strait, 1921, pp. 5, 7 (identity).

Asterias radiata W. B. CARPENTER, Philos. Trans. Roy. Soc., vol. 156, 1866, p. 680, footnote (error for *pectinata*).

Comatula (*Actinometra?*) *hamata* KUHL and VAN HASSELT, in HERKLOTS, Bijdragen tot de Dierkunde, Afl. 9, 1869, p. 10 (description; near Cape Bantam; 12 toises); pl. 11 (colored).

Actinometra solaris VON GRAFF, Das Genus *Myzostoma*. 1877, pp. 19, 22 (near Bohol, Philippines; myzostomes).—BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 164 (in part; Prince of Wales Channel; Warrior Reef; Port Curtis; Arafura Sea; Thursday I.).—VON GRAFF, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 14, 20 (myzostomes); p. 37 (Bohol, Philippines; myzostomes); vol. 20, pt. 61, 1887, pp. 5, 7, 11 (Moluccas; myzostomes).

Actinometra, sp. P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 154 (one of the 3 species taken by the *Challenger* in cruising from Cape York to the Philippine Is., etc.; the other 2 are forms of *C. solaris*).

Actinometra cumingii P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 154 (10-armed species from Malacca).—BELL, Report Zool. Coll. H. M. S. *Alert*, 1884 p. 167 (Malacca; Queensland record = *Comanthus parvicirra*).

Actinometra affinis (Lütken, MS.) P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 517; Proc. Zool. Soc. London, 1882, 1883, p. 747; *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 287 (Java).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 437 (status of the name); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (synonym of *Comatula pectinata*).

Actinometra cumingi P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 301 (Malacca; Port Molle record is *Comanthus parvicirra*).—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 35 (identity).

Antedon irregularis (part) BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 161 (Prince of Wales Channel); Proc. Zool. Soc. London, 1894, p. 394 (Baudin I.).

?*Actinometra purpurea* BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 165 (Dundas Strait).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 714 (identity).

?*Actinometra pectinata* BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 165 (Dundas Strait).

Actinometra, sp. juv. BELL, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 170 (Dundas Strait; possibly *purpurea*).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 31 (identity); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 79 (identity).

Actinometra parvicirra (part) BELL, Proc. Zool. Soc. London, 1894, p. 394 (Bassett-Smith Bank, 9 fathoms).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 719 (of Bell, 1894 = *pectinata*, in part); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, pp. 10, 77 (same).

Antedon cumingii PFEFFER, Abhandl. Senck. naturforsch. Gesellsch., vol. 25, 1900, p. 85 (Ternate).

Comanthus cumingii A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 221 (refers to Philippine specimens recorded under this name); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 207 (*Albatross* stations 5137, 5142; description).

Comatula rosularis (B. M., MS.) A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 80 (=*Comatula pectinata*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 89 (same).

Actinometra echinoptera (B. M., MS.) A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 80; Smiths. Miscell. Coll., vol. 61, No. 15, 1913, pp. 10, 75 (no locality).

Comatula (*Comatula*) *pectinata* A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 27 (in key; range); p. 30 (synonymy; detailed account; stations 49*a*, 50, 79, 79*b*, 96, 99, 162, 164, 273, 282, 285, 294, 299).

Diagnostic features.—The cirri have 10–15 (usually 12–14) segments; they are regularly distributed about the periphery of the centrodorsal. If there are gaps in the row of cirri, these never occur in such a way as to segregate the cirri in the interradial angles.

The arms may be very broad in the basal half, rapidly tapering distally, or long and slender and evenly and slowly tapering. Not infrequently the posterior arms are short and broad and the anterior slender and elongated. Sometimes the distal portion of the arms is greatly produced and attenuated.

Specimens from Singapore and Java with slender arms occasionally have 11 or 12 arms, the IIBr series being 2 (1+2). But all individuals from the other portions of the range and all broad-armed specimens, have, so far as known, 10 arms only.

Description of the form with very stout arms from the Philippine Islands.—The centrodorsal is thin discoidal, with the moderate or rather small bare polar area flat or very slightly concave. The cirrus sockets are arranged in a single crowded and somewhat irregular marginal row which usually shows more or less extensive gaps where the cirrus sockets have been obliterated, thus indicating a tendency toward a cirrusless condition.

Cirri XI–XVI, 10–14, from 10 to 13 mm. long. The first segment is very short, and the following gradually increase in length to the fourth, which is about as long as broad. The fifth segment is the longest, from one-third to nearly one-half again as long as broad. The sixth segment is somewhat shorter, and the seventh is about as long as broad. The succeeding segments are subequal, from half again to nearly twice as broad as long. The antepenultimate segment is about as long as broad. The penultimate segment is very small, usually about half as long as the antepenultimate and nearly or quite twice as broad as long. The cirri are perfectly smooth dorsally and ventrally; they are rounded in cross section in the proximal half, but become laterally flattened in the distal half, and therefore here considerably broader in lateral view. The opposing spine is small and blunt, often quite absent, median to subterminal in position. The terminal claw is stout basally, but tapers rapidly; it is about as long as the antepenultimate segment and is strongly curved basally, becoming straighter distally.

The ends of the basal rays are visible as minute tubercles in the angles of the calyx.

The radials are entirely concealed by the centrodorsal, or can just be made out in the interradial angles of the calyx over the ends of the basal rays. The IBr_1 are very short, bandlike, with the distal edge straight and the proximal somewhat convex with a prominent median groove or furrow. The IBr_2 (axillaries) are broadly triangular, twice as broad as long. The IBr series and the first 2 brachials are in close lateral contact.

The 10 arms are about 130 mm. in length. The first brachials are small and short, very slightly wedge-shaped. The second brachials are somewhat larger and very obliquely wedge-shaped. Both the first and second brachials are in contact interiorly. The distal edge of the second brachials is parallel to the outer edge of the radials. The third brachials are exceedingly short and oblong. The fourth are almost twice as long and triangular with the apex near the interior side. The next 4 brachials are slightly wedge-shaped, very short, three or four times as broad as long, and with the articular tubercles strongly developed. The succeeding brachials become triangular, about twice as broad as long, with the distal edge concave, very gradually increasing in length distally and in the outer part of the arm being very obliquely wedge-shaped and nearly as long as broad. The arms gradually increase in diameter from the base to the twelfth-twentieth brachials, thence gradually decreasing in width distally. The distal ends of the brachials are prominent, though not overlapping. The brachials in the proximal portion of the arm appear swollen, this feature becoming less and less marked distally.

Syzygies occur between brachials 1 + 2 and 2 + 3, often also 3 + 4, again between brachials 11 + 12 or 12 + 13, and thence at intervals of usually 6 (sometimes as few as 4) muscular articulations.

Notes.—The specimen from the China Sea recorded by Hartlaub resembles in its general habitus the two from Cooktown, Queensland.

The specimen from *Albatross* station 5276 is a fine example with only VI rather short and slender cirri which are irregularly distributed about the circumference of the centrodorsal, not being segregated in the interradial angles like the cirri of *C. purpurea*.

In the two examples from Sorsogon, Luzon, the anterior arms are about 125 mm. in length.

In the specimens collected by Semper at Bohol, P_1 and the following pinnules have keels on the basal segments and much less massive brachials and pinnule segments than *C. solaris*.

The largest specimen from *Siboga* station 99 has the cirri XIII and the arms 75 mm. long. Another has 11 arms 70 mm. long, the posterior arms being 55 mm. long; the cirri are XI. There are from this station 4 others similar to the preceding, and 6 more of medium and small size. All of the specimens are of the slender armed type.

Of the 3 specimens collected by Dr. Th. Mortensen off Jolo in about 22 meters, one has exceptionally stout arms, one has slender arms 120 mm. long, and the third is small with arms 30 mm. long. Of those collected in about 36 meters on March 17, 1914, one has the arms about 90 mm. long and moderately stout. The cirri are XVII, 13, 7.5 mm. long, about half slender and almost straight, the other half being stout and having the distal portion strongly recurved. A similar but somewhat smaller specimen has the cirri XIII, 12–13, all of the stout type. The 3 other individuals are similar, but smaller. The 6 collected in about 36 meters on March 21, 1914, have the arms intermediate between the slender and the stout form. One of these has 12 arms, 2 IIBr 2 (1+2) series being present. Of the 3 specimens dredged in about 36–55 meters, 1 has the arms about 80 mm. long and the other 2 are smaller.

The specimen from *Siboga* station 96 is small, with the arms 25 mm. long.

The single specimen from *Albatross* station 5358 is a fine example, with the cirri XIV, 13, from 13 to 15 mm. long and rather stout.

The specimen from British North Borneo is of the slender-armed type, with the arms 120 mm. long.

The specimen from *Siboga* station 79*b* is small, with the arms only 27 mm. long.

The example from *Siboga* station 79 is of the slender-armed type; the cirri are XII, 13–14, and the arms are about 90 mm. long.

The specimen in the Indian Museum from "India" is small.

The single individual from Malacca (the type of *Comatula cumingii*) is young, with the arms 35 mm. long; the cirri are VII, all broken off at the base.

The larger of the two specimens from the southern portion of the Straits of Malacca has the cirri with 15–17 segments, 15 mm. long. In neither specimen are the arms swollen basally.

The specimen from Singapore in the British Museum is of the slender-armed type.

The characters of representative specimens from Singapore as shown by the collections of Mr. Svend Gad are as follows: The largest have the arms from 125 to 140 mm. in length. An example typical for the locality has the arms 110 mm. long, not enlarged proximally, and the cirri XIII, 10–12. A few specimens are of the stout-armed type, one such having the cirri XIII, 12–13, 10 mm. long and the arms 65 mm. long. A number of specimens are intermediate between the stout and the slender armed types, the grooved anterior arms being slender and the ungrooved posterior arms being much shorter and stout. In one of these the anterior arms are 110 mm. and the posterior 50 mm. in length. Eight of the specimens have 11 arms, the single IIBr series present being invariably 2 (1+2).

A specimen from Singapore has 17 arms 50 mm. long. All but one of the arms, which arises from a IBr series, are in various stages of regeneration; the arms of each pair are always of the same length. The division series and arms resemble those of *Comatula rotalaria,* but the arms are not broadened. The centrodorsal is discoidal, very thin, 3 mm. in diameter. The cirri are arranged in a single marginal row, which is deficient in two places. The cirri are XVI, 12–13, 8 mm. long, and rather weak. The first segment is short, the second is from half again to twice as broad as long, the third is as long as, or slightly longer than, broad, the next 2 or 3 are about half again as long as broad, and the remainder are about one-third longer than broad. The color in alcohol is brown, each arm having a white mediodorsal stripe; regenerating arms and portions of arms are brownish white.

The specimen from the Kei Islands expedition station 90 is of the slender-armed type; the anterior arms are 120 mm. in length.

The 3 specimens from the Kei Islands expedition station 85 are all of the slender-armed type and are light brown in color, with a light mediodorsal stripe bordered on either side with darker. In one the 10 arms are 115 mm. in length; the cirri are XVI, 15, from 14 to 15 mm. long; P_2 and P_3 have the first-third, especially the second, segments strongly carinate. A second specimen is of about the same size, but has 11 arms, one IIBr 2 series being present; the cirri are XIII, 15. The third specimen is smaller, with the 10 arms 85 mm. long; the cirri are XI, 13.

The specimen from the Kei Islands expedition station 73 has 10 arms up to 150 mm. in length; the cirri are V (with numerous additional more or less undeveloped), 13–15.

Of the 6 specimens from the Kei Islands expedition station 67, one has 17 arms, of which 8 are small and regenerating. Another has 16 arms; of the 6 IIBr series present 1 is of full size, 1 is almost of full size, 2 are half grown, and 2 are small. The last 2 are situated on a small IBr series, which apparently is regenerating. All of the IIBr series are 2 (1+2). The arms were probably about 140 mm. long. The centrodorsal is thin discoidal, oval, sunken in the center, and measures 5 by 3.5 mm. The cirri are XIII, 12, with the distal half moderately compressed laterally and moderately recurved. This specimen is light in color and is of the slender armed type. A very large specimen has the 10 arms probably 190 mm. long; the arms are broadened basally, becoming 4.5 mm. wide at about the fourteenth brachial, thence slowly tapering distally. There is a trace of a low, blunt, median keel. The centrodorsal is thin discoidal, slightly concave dorsally, 4 mm. broad. The cirri are XVI, 12–13, with several more incompletely developed; they are slender and weak, from 10 to 15 mm. long. The color is deep purple, with the regenerating arm tips yellow brown. Another has the 10 arms moderately stout, the longest 155 mm. long; the cirri are XIX, 14, rather strongly recurved distally. Another specimen is similar to this but slightly smaller. The last specimen resembles that preceding, but has 11 arms.

One of the specimens from the Kei Islands expedition station 111 has 10 arms 190 mm. long. The arms are stout, though not so stout as in the extreme of the stout-armed form; they increase slowly in width to about the twelfth brachial, thence taper slowly distally and become slender in the outer third. There is a trace of a median dorsal carination. The centrodorsal is thin discoidal, 3.5 mm. in diameter. The cirri are XVI, 10–12, rather weak and slender. In another the arms are 170 mm. long, stout, 3.3 mm. broad at the base and increasing in width to 4 mm. at the fourteenth brachial, thence slowly tapering distally. The centrodorsal is 3.5 mm. in diameter, thin discoidal, with a gently concave dorsal surface. The cirri are XX, 13–14, from 12 to 15 mm. long. A large stout specimen resembles the preceding. The centrodorsal is thin discoidal, slightly concave dorsally, 2.5 mm. in diameter. The cirri are XVI, 14, from 13 to 15 mm. long. Another specimen has the arms 130 mm. long, rather strongly broadened at the base. The cirri are XVI, 12–13 (usually 13), from 10 to 13 mm. long. Another individual has 13 arms, which are more slender than those in the preceding specimens. There is a single IIBr 2 (1+2) series on each of 3 postradial series. On the arms arising from IIBr series the first 4 brachials are united into 2 syzygial pairs. The centrodorsal is thin discoidal, flat, 5 mm. in diameter. The cirri are XVI, 14–15, 15 mm. long. The last specimen resembles the one just preceding, but has only 10 arms. The centrodorsal is thin discoidal, flat, 4 mm. in diameter. The cirri are XVI, 14–16, from 13 to 15 mm. long.

The specimen from the Kei Islands expedition station 101 has 15 arms up to 180 mm. in length. The arms are moderately stout. The centrodorsal is thin discoidal, with a flat circular dorsal pole 4 mm. in diameter. The cirri are XVIII, 15–16 (usually 16), and are arranged in a single marginal row. There are 4 IIBr 2 (1+2) series and a single IIIBr 2 (1+2) series, the last externally developed. Following this the inner arm has the first 4 brachials united into 2 syzygial pairs, while the first syzygy on the outer arm is between brachials 2+3. The second segment of P_2 and P_3 is very strongly carinate on some arms, but much less strongly carinate on others.

In the type of *Comatula* (*Actinometra*?) *hamata* from Cape Bantam as described by Kuhl and van Hasselt the centrodorsal is small, smooth, not concave, 4 mm. in diameter, bearing marginal cirri.

The cirri are XX, 13–14, slightly compressed laterally. The opposing spine is conical and toothlike and the terminal claw is elongated and hooklike.

The 10 arms are 120 mm. in length and from 3 to 3.5 mm. in width. They are rounded dorsally and carry 60 or 61 pairs of pinnules. The brachials are triangular or wedge-shaped, but show no trace of a keel. The pinnules are borne on the longer side.

The pinnules seem to be longest toward the middle of the arms. From the base they increase in length, and then diminish very regularly. Of the pinnule segments, which number from 20 to 22, the 5 or 6 basal are the broadest and longest, the outer being less broad and square in form; the terminal segments are armed with a lateral process (by which is apparently meant a tooth of the terminal comb). The longest pinnules are from 12 to 14 mm. in length.

The coloration dorsally is, as shown in the figure, a very light violet gray; each arm bears 2 narrow lines of very dark reddish brown or purple, one on either side of the median line, and numerous narrow well-spaced cross bands of the same color. The pinnules and the cirri, the latter shown as brownish, seem to have lines of a similar color. The centrodorsal is brilliant carmine red.

Kuhl and van Hasselt add that this individual lived for 6 hours half submerged in water, to which it imparted, while still alive, a red color.

The specimen from Java (*Actinometra affinis* Lütken, MS.) has 12 arms (not 11, as stated by Carpenter) which are about 65 mm. long. In its actual size it is but little smaller than specimens from Singapore, with the arms 110 mm. long. The 2 IIBr series are 2 (1+2). Carpenter noted that in this specimen P_1, P_2, and P_3 and the corresponding pinnules on the inner side of the arm have strong keels on the lower segments, while there are lesser keels on P_4 and P_d. He remarked that the same thing occurs in some individuals from Bohol in Semper's collection; it occurs also in others which I have examined from the Philippines.

The specimen from Banka Strait is small, with the arms about 70 mm. long.

The specimen from Billiton in the British Museum has moderately stout arms and XV cirri. The one from the same locality recorded by Koehler has 13–15 cirrus segments; the arms are 60 mm. long.

Of the specimens from *Siboga* station 49*a*, 27 are fully grown, with the arms up to about 130 mm. in length, while 31 represent various immature stages. All are more or less pronouncedly of the broad-armed type. One of the fully grown ones is purple, the others being yellow brown. One of the young is orange, the others yellow or yellow brown. This series closely resembles that from *Siboga* station 162.

Two of the specimens from *Siboga* station 50 have the anterior arms about 110 mm. long; another has the anterior arms 90 mm. long and the posterior 60 mm. long, with 4 ungrooved. The last is small. In these individuals the arms are rather slender, with only a suggestion of an approach to the stout type.

The single specimen from *Siboga* station 294 is young.

The specimen from *Siboga* station 299 has moderately stout arms 115 mm. long.

The largest specimen from *Siboga* station 285 has the anterior arms 95 mm. long and the posterior 45 mm. The arms are moderately stout, 6 being grooved and 4 ungrooved. The cirri are XIII. A second individual is similar, but slightly smaller. The last is small, with the arms about 20 mm. long; the syzygies between the elements of the IBr series and the first 2 brachials are perfectly developed.

In the specimen from *Siboga* station 282 the anterior arms are 150 mm. long and the posterior 70 mm. Four of the arms are ungrooved. The arms are very stout, especially the posterior. The cirri are stout and strongly curved, XII, 12–13.

The specimen from the Malay Archipelago in the Indian Museum is a fine example, with the arms 150 mm. long and the cirri XI, 13–14, 10 mm. long. The arms are slightly swollen in the proximal portion. The one from the Malay Archipelago in 292 meters has the arms rather strongly swollen basally, 90 mm. long.

Linné's original type from the Indian seas was redescribed by A. J. Retzius and by Johannes Müller. Müller said that the centrodorsal is concave in the center and the cirri are wholly marginal. The cirri are XVI, 13. The cirrus segments are scarcely higher than broad, and the last bears an opposing spine. The radials are excessively short. The arms are narrower at the base than further out. The brachials are wedge-shaped, the wedges alternating in position. In the mid-line on the dorsal side they show traces of a keel. The first 4 brachials are united in 2 syzygial pairs. The distal intersyzygial interval is from 3 to 9 muscular articulations. P_1 and P_2 are of equal size. The first 2 segments of P_2 are strikingly broadened upward; that is, carinate. P_3 is small. The pinnules following are larger and increase rapidly in length. The segments of the pinnules are broader than high. On the dorsal surface of the arms there are very regularly 2 black longitudinal lines which are separated in the mid-dorsal line by a light stripe. Müller says that except for the color scheme this form is very similar to *C. purpurea.*

The single specimen from the Danish expedition to the Kei Islands station 20 is small. One of the specimens from station 30 has the anterior arms 120 mm. and the posterior 50 mm. in length; the arms are much swollen. The cirri are VII, 11, small, weak, and strongly curved. The arms are rather narrowly banded light and dark yellow brown. The other specimen is small.

The largest specimen from *Siboga* station 162 has the anterior arms 135 mm. and the posterior arms 85 mm. in length, all of the arms being very broad and stout. Five of the arms are ungrooved. Another large specimen has the anterior arms 120 mm. and the posterior 60 mm. long; 5 of the arms are ungrooved. A third specimen has the anterior arms about 100 mm. and the posterior 60 mm. long, all of the arms being stout and broad; 5 of the arms are ungrooved, and on the others only the distal pinnules are grooved. A fourth, also of the broad-armed type, has the posterior arms 60 mm. long, very stout, stouter than the anterior arms; 5 of the arms are ungrooved; the cirri are X, 10–11, from 8 to 9 mm. long. A fifth resembles the preceding. The 7 small specimens are similar. The broadening of the arms is marked in individuals with an arm length of only 35 or 40 mm.

In the specimen from *Siboga* station 164 the anterior arms are 120 mm. in length and the posterior 70 mm. Six of the arms are grooved and four ungrooved. On the former only the distal pinnules are grooved. All of the arms are rather stout, but not excessively so. The centrodorsal is greatly reduced and bears only II cirri, one 7 mm. long with 12 segments, the other 6.5 mm. long with 11 segments. There are also two rudimentary cirri. The color is yellow brown, each articulation with two dark spots, one on either side of the median line; the articulations in the basal portion of the pinnules bear single dark spots.

The 2 specimens recorded by Hartlaub from Amboina are remarkable for their entirely white color as well as for the absence of a longitudinal band on the arms. They are of rather small size and have relatively short arms, so that their appearance is compact.

Of the 2 specimens from *Siboga* station 273 the larger has the anterior arms 120 mm. and the posterior 45 mm. in length; the arms are moderately stout; 5 of them are grooved and 5 ungrooved. The cirri are XIV, 10, from 7 to 9 mm. long. The color is yellow brown, with a narrow mediodorsal line of lighter; the pinnules are deep violet. The smaller specimen has the arms 80 mm. long, moderately swollen, and the cirri XIII.

Dr. H. L. Clark says of the 13 specimens from the Abrolhos Islands that he examined, 9 from off Long Island and 4 from near First Island, that they are all brown, pale brown, or yellow brown in color. They are all small, only 2 or 3 having arms 100 mm. long. The cirri range from I to XIV, with the segments 10–14, but in no case are they arranged in pairs at the corners of the centrodorsal.

Dr. Torsten Gislén's redescription of this species, based on Mjöberg's specimens from northwestern Australia, is as follows:

The centrodorsal is discoidal, slightly sunken in the center, from 1.5 to 3 mm. in diameter. In full-grown specimens it almost covers the radials, but in immature individuals it leaves them bare.

The cirri are X–XVIII, 9–15 (usually 10–12), from 5 to 9 mm. in length. The first segment is twice as broad as long, closely united with the centrodorsal. The second is as long as broad. The third-eighth segments are slightly longer than broad, the articulations between them very oblique in lateral view. The opposing spine is small but distinct, equal to one-fourth the width of the penultimate segment in height. The terminal claw is long and sharp, half again as long as the penultimate segment, in its proximal portion abruptly recurved (at an angle of from 60° to 90°).

The 10 arms are of very different lengths. The long anterior arms are more slender than the others, from 65 to 95 mm. long, and are always provided with ambulacral furrows. The posterior arms are about two-thirds the length of the anterior, from 35 to 45 mm. long, and are thicker and more robust, and usually without ambulacral furrows. The brachials from the eighth to the thirtieth are much enlarged and broadened.

The radials are in most cases concealed by the centrodorsal; if not, there is a dorsal tubercle proximally in the median line. The elements of the IBr series and the first 2 brachials are united by syzygy. The IBr_1 are short and bandlike, laterally united, about five times as broad as long. The IBr_2 (axillaries) are pentagonal, with the distal angle of more than 90° and often with a shallow dorsal notch at the point.

The first brachials are more or less united interiorly. About the first 7 brachials are discoidal, those following being produced distally in a tonguelike process alternately on the right and left. A feebly developed keel, usually light colored, runs along the dorsal median line of the arms.

Syzygies occur between brachials 1+2 and 3+4, then at about the tenth brachials, again at about the sixteenth brachial, and distally at intervals of 6 muscular articulations.

P_1 is from 9 to 11 mm. in length and consists of 30–45 segments, of which the distal 25–30 bear teeth. The second and third segments of P_1 and to a still greater extent of P_2 are broadened and carinate. P_2 is a little shorter than P_1 with up to 30 segments and a comb consisting of from 10 to 25 teeth. From P_3 onward the pinnules are composed of shorter and stouter segments; they are 4 or 5 mm. in length, composed of 15–20 segments, and do not bear combs. The 4 outermost segments have the dorsal spines more developed and strengthened by hooks, of which there are 1 or 2 rows on each segment with about 3 hooks in each row. On the pinnules immediately following P_2 there are rudimentary combs, the teeth of which are shaped like small ventrodistal prominences.

Doctor Gislén pointed out that of the 11 specimens which he determined as *C. pectinata* none had a complete and continuous row of cirri, there being always from one to four breaks or gaps in the series.

The 2 specimens in the British Museum from near Cape Voltaire are both small.

The 2 examples from Baudin Island in 14.6–27.4 meters are both small.

One of the specimens from Holothuria Bank (62.1 meters) has 11 arms.

The single specimen from Dundas Strait is young.

One of the specimens from Mer, Murray Islands, in the collection of the Museum of Comparative Zoölogy has the arms 190 mm. long and the cirri XV, 13–14, thus showing a close approach to *C. solaris*. Of the other specimens the largest has the arms about 150 mm. long.

The 2 specimens from Cooktown, Queensland, recorded by Hartlaub have a very small centrodorsal. Their posterior arms are markedly shorter than the anterior and are ungrooved.

The specimen from Albany Passage in the Australian Museum is a fine example, with the cirri XIX, 14–15, from 10 to 12 mm. in length.

The specimen labeled Port Jackson has the cirri XVI, 11–13, 10 mm. long and the arms 100 mm. long, somewhat swollen basally.

In a specimen from Warrior Reef, as noted by Bell, the characteristic keel on the lower pinnule segments is developed. The cirri do not seem to have been more than XII, and the number of cirrus segments would appear to be less than 15.

Regarding the specimens from *Alert* station 144, probably Thursday Island, Bell noted that they were somewhat smaller than those described under the name *robusta* by Carpenter, and that the lower brachials are not so distinctly knobbed, while there is a very faint carination on the basal segments of P_2.

Professor Döderlein's specimens from Thursday Island have the cirri VI–IX, 12–14; a few of the segments are longer than broad. On one specimen with an arm length of from 65 to 42 mm., P_1 is about 14 mm. long. In another with the arms from 50 to 30 mm. long, P_1 is about 18 mm. long. The pinnules of the first 2 pairs are long and slender, standing upright with the distal portion curled over. The comb is restricted to the tip, and is sometimes prominent. The pinnules of the second pair are shorter than those of the first pair. Both pinnules of the second pair bear on the second segment, and sometimes also on the third and fourth, a high sharp keel which is occasionally only feebly developed. The following pinnules extend horizontally; they are remarkably broad and the tip is not incurved. The tip of the pinnules of the third pair shows only a slight tendency to be incurved. These pinnules have no terminal combs, and the proximal segments have no keels. P_3 and P_4 are of about equal size and are smaller than P_2. The pinnules following become longer again. In the outer half of the arms the pinnules again become slender. Two or three of the shorter arms are ungrooved. The dorsal keel on the arms is slightly developed. The disk is smooth. The color is red-brown. A young specimen with the arms 10 mm. long has X cirri, of which the segments are considerably longer than broad. All the pinnules are slender.

In *Comatula pectinata*, specimens with more than 10 arms are always of the slender-armed type, the stout-armed form never, so far as known, having more than 10 arms.

The difference in length between the grooved anterior and the ungrooved posterior arms reaches a maximum in this species (see vol. 1, pt. 1, figs. 45, *a*, *b*, p. 79; vol. 1, pt. 2, fig. 163, p. 86), the posterior arms sometimes being scarcely one-third the length of the anterior.

The restriction of the ambulacral grooves is sometimes, as in the much smaller *C. micraster*, carried to an extreme, only 4 of the arms being grooved, while 6 are ungrooved.

The articulation between the elements of the IBr series and that between the first 2 brachials apparently always begin as a typical synarthry, later developing along two different lines. In some cases the articulations simply become closer and closer, so that the ultimate result is almost a close suture, the joint line appearing externally as a uniform fine straight line and the joint faces showing scarcely more than a trace of the typical synarthrial sculpture (vol. 1, pt. 1, fig. 36, p. 75) which may be confined to a relatively small area, while, on the other hand, they may develop radiating ridges, so as gradually to become transformed into an almost perfect syzygy (vol. 1, pt. 1, fig. 39, p. 75). As a rule the extremely close synarthry is characteristic of the slender-armed form and the syzygy of the stout-armed type. All forms of intermediates between these two types of articulation occur.

Dimorphism.—There are two forms of dimorphism in this species which are not correlated with each other.

In some individuals the arms are long and slender, tapering gradually and evenly from the base to the delicate tip, while in others they are short and very stout, broadening from the base to about the fourteenth brachial and from that point tapering rapidly distally. The slender and stout forms are very different in appearance, but intergrades between the two are not infrequent. Very commonly the posterior ungrooved arms are much shorter and stouter than the grooved anterior arms. (See vol. 1, pt. 2, fig. 163, p. 86.)

As a rule, specimens in which the calices are of the same size will have arms of the same length. More or less frequently, however, an individual is found in which the distal portion of the arm instead of being moderately stout and tapering evenly to the tip is attenuated and greatly elongated, with very long brachials and widely separated pinnules, so that it resembles more or less closely the distal portion of the arms in *Antedon.*

This curious prolongation and attenutation of the distal portion of the arms occurs in both the slender and the stout-armed forms.

Both types of dimorphism occur in the same way in *Comactinia echinoptera.* But in the latter species they seem to show a definite relation to environmental conditions which is scarcely the case in *Comatula pectinata.*

Abnormal specimens.—The specimen from Java in the Copenhagen Museum bearing the name *Actinometra affinis* Lütken, MS., has 12 arms.

Individuals with 11 arms have been recorded from *Siboga* station 99 (1), Singapore (8), the Philippines (1), and Holothuria Bank in 62.1 meters (1).

A detached arm from Singapore shows distal arm branching.

Commensalism.—One of the specimens from Singapore has a small *Ophiomaza* with the disk 4 mm. in diameter covering the ventral surface of the disk. This ophiuran (see vol. 1, pt. 2, p. 643) is common at Singapore, but has not previously been reported in connection with this crinoid.

Geographical variation.—The stout-armed form of this species predominates and reaches an extreme development in the eastern portion of its range, from the Philippine Islands southward to and including New Guinea and Australia. Westward the slender-armed form becomes more common and the stout-armed form less and less extreme, so that in the Java Sea the slender armed form greatly predominates, and the few individuals which may be said to represent the stout-armed type have the characteristic features only moderately developed, and commonly confined to the ungrooved posterior arms.

Since individuals with more than 10 arms are exclusively of the slender-armed type, they naturally are commonest in the Java Sea. Here specimens with more than 10 arms, usually 11, are not uncommon, while on the northern coast of Java and at Singapore the number of arms may rise as high as 17. Except in the Java Sea an increase in the number of arms over 10 is very rare; a single individual with 12 arms is recorded from Jolo, in the Philippines, and one with 11 arms is recorded from Holothuria Bank, in northwestern Australia.

On the northwestern coast of Java individuals of enormous size, larger than the usual run of *C. solaris*, are found.

If it is considered desirable to recognize the major varieties of this species nomenclatorially, the following names are available:

The stout-armed form is typical *pectinata* Linné, as is evident from Retzius' redescription of the Linnean type specimen.

The slender-armed form must be known as *cumingii* J. Müller.

The multibrachiate form must bear the name *affinis* Lütken.

The giant form must be known as *hamata* Kuhl and van Hasselt.

Localities.—China Sea [Hartlaub, 1891].

Albatross station 5276; China Sea, in the vicinity of southern Luzon; Malavatuan Island (NW.) bearing N. 61° 30′ E., 6.5 miles distant (lat. 13° 49′ 15″ N., long. 120° 14′ 45″ E.); 32.9 meters; shells, pebbles, and sand; July 17, 1908 [A. H. Clark, 1911].

Sorsogan, southern Luzon, Philippines (2, M. C. Z., 659).

Near Bohol, Philippines; Prof. C. Semper [von Graff, 1877, 1884; P. H. Carpenter, 1882, 1888].

Challenger; Samboanga, Mindanao, Philippines; 18.2 meters [P. H. Carpenter, 1888; A. H. Clark, 1913] (2, B. M.).

Siboga station 99; anchorage off North Ubian (lat. 6° 07′ 30″ N., long. 120° 26′ 00″ E.); 16–23 meters; lithothamnion bottom; June 28–30, 1899 [A. H. Clark, 1918] (12, Amsterdam Mus.).

Albatross station 5138; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 34.7 meters; sand and coral; February 14, 1908 (1, U.S.N.M., 34919).

Albatross station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38.3 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908] (3, U.S.N.M., 34924, 34925). Pl. 20, fig. 49; pl. 33, fig. 100.

Albatross station 5139; in the vicinity of Jolo; Jolo Light bearing S. 51° W., 3.6 miles distant (lat. 6° 06′ 00″ N., long. 121° 02′ 30″ E.); 36.5 meters; coral sand; February 14, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34921).

Albatross station 5137; in the vicinity of Jolo; Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36.5 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908].

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; about 22 meters; sand and coral; March 17, 1914 (3); about 36 meters; lithothamnion; March 17, 1914 (5); about 36 meters; March 21, 1914 (6); about 36–55 meters; sand and coral; March 19, 1914 (3).

Siboga station 96; southeastern side of the pearl banks, Jolo archipelago; 15 meters; lithothamnion bottom; June 27, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Albatross station 5152; Tawi Tawi group, Jolo Archipelago; Pajumajan Island (W.) bearing S. 2° W., 2 miles distant (lat. 5° 22′ 55″ N., long. 120° 15′ 45″ E.); 62.1 meters; white sand; February 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34918).

Albatross station 5163; Tawi Tawi group; Observation Island bearing N. 79° W., 6.7 miles distant (lat. 4° 59′ 10″ N., long. 119° 51′ 00″ E.); 51.1 meters; coral sand, February 24, 1908 (1, U.S.N.M., 34920).

Albatross; Philippine Islands [A. H. Clark, 1908] (1+, U.S.N.M., 34923, 26278).

Albatross station 5358; off Sandakan, Borneo; Sandakan Light bearing S. 34° W., 19.7 miles distant (lat. 6° 06′ 40″ N., long. 118° 18′ 15″ E.); 71.2 meters; mud; January 7, 1908 [A. H. Clark, 1911] (1, U.S.N.M., 34922).

British North Borneo; Herr Pagel [A. H. Clark, 1912; Hartmeyer, 1916] (1, Berl. M., 6374 [4744]).

North Celebes [P. H. Carpenter, 1888].

Siboga station 79*b*; Pulu Kabala-dua, Borneo Bank; 22 meters; coral sand; June 12–13, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 79; Borneo Bank (lat. 2° 43′ 00″ S., long. 117° 44′ 00″ E.); 41–54 meters; fine coral sand; June 12, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

"India" (probably Ceylon) [A. H. Clark, 1912]; same, as "Ceylon" [H. L. Clark, 1915] (1, I. M.).

Malacca; Hugh Cuming [J. Müller, 1849; P. H. Carpenter, 1879, 1881, 1888; A. H. Clark, 1908, 1911, 1912] (1, Berl. M., 1051).

Southern portion of the Straits of Malacca [A. H. Clark, 1912] (2, U.S.N.M., 34945; I. M.).

Singapore [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Singapore; Svend Gad [A. H. Clark, 1909] (76+, U.S.N.M., 36259, E. 1084; C. M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 90; Sebesi Strait, between Sumatra and Java; 36 meters; hard bottom; August 1, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 85; Sunda Strait (lat. 5° 53′ S., long. 105° 34′ E.); 25 meters; July 31, 1922 (3). Pl. 38, fig. 107.

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 73; Java Sea, north of western Java (lat. 5° 57′ S., long. 105° 57′ E.); 30 meters; hard bottom; July 28, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 104; Java Sea, north of western Java (lat. 5° 52′ S., long. 106° 04′ 05″ E.); 38 meters; stones and sponges; August 4, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 67; Java Sea, north of western Java (lat. 5° 48′ S., long. 106° 12′ E.); sand; July 27, 1922 (6). Pl. 34, fig. 101; pl. 36, fig. 103; pl. 37, fig. 104; pl. 38, figs. 105, 106.

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 111; Java Sea; 27 meters; sand and shells; August 7, 1922 (6). Pl. 35, fig. 102.

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 101; Java Sea; 49 meters; sand, stones and sponges; August 5, 1922 (1).

Near Cape Bantam, western Java; attached to a mooring line at 23.4 meters; Kuhl and van Hasselt [Kuhl and van Hasselt, in Herklots, 1869].

Java [P. H. Carpenter, 1882, 1888; A. H. Clark, 1908, 1909] (1, C. M.).

Java [Gislén, 1924].

Banka Strait, between Java and Banka; Prof. E. von Martens [A. H. Clark, 1912] (1, Berl. M., 1842).

Banka [P. H. Carpenter, 1888].

Billiton [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Billiton [Koehler, 1895].

Siboga station 49*a*; Sapeh Strait, between Sumbava and Komodo Island (lat. 8° 23′ 30″ S., long 119° 04′ 36″ E.); 69 meters; coral and shells; April 14, 1899 [A. H. Clark, 1918] (58, U.S.N.M., E. 481; Amsterdam Mus.).

Siboga station 50; Bay of Badjo, western coast of Flores; down to 40 meters; mud, sand, and shells according to locality; April 16–18, 1899 [A. H. Clark, 1918] (4, Amsterdam Mus.).

Siboga station 294; south of the western end of Timor (lat. 10° 12′ 12″ S., long. 124° 27′ 18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 299; Boeka or Cyrus Bay, southern coast of Rotti (lat. 10° 52′ 24″ S., long. 123° 01′ 06″ E.); down to 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 285; anchorage on the southern coast of Timor (lat. 8° 39′ 06″ S., long. 127° 04′ 24″ E.); 34 meters; on the border line between coral and mud; lithothamnion; January 18, 1900 [A. H. Clark, 1918] (6, Amsterdam Mus.).

Siboga station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Malay Archipelago [A. H. Clark, 1912] (1, I. M.). Same, 292 meters [A. H. Clark, 1912] (1, U.S.N.M., 34932).

Indian seas [Linné, 1758; A. J. Retzius, 1783, 1805; J. Müller, 1843; P. H. Carpenter, 1879, 1888; A. H. Clark, 1908, 1911, 1912, 1918].

Moluccas [von Graff, 1884; P. H. Carpenter, 1888].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 20; about 50 meters; sand and shells; April 14, 1922 (1); station 30; about 40 meters; sand and shells; April 18, 1922 (2).

Ternate [Pfeffer, 1900].

Siboga station 162; western coast of Salawatti, between Loslos and Broken Islands; 18 meters; coarse and fine sand with clay and shells; August 18, 1899 [A. H. Clark, 1918] (20, U. S. N. M., E. 486; Amsterdam Mus.).

Siboga station 164; off Misool (lat. 1° 42′ 30″ S., long. 130° 47′ 30″ E.); 32 meters; sand, small stones, and shells; August 20, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Amboina [Hartlaub, 1891].

Siboga station 273; off Pulu Jedan, eastern coast of the Aru Islands; pearl banks; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Long Island, Abrolhos group, Western Australia [H. L. Clark, 1923].

First Island, Abrolhos, Western Australia [H. L. Clark, 1923].

Shark Bay, Western Australia [A. H. Clark, 1911].

Mjöberg's station 2; Cape Jaubert, south of Broome, Western Australia (about 19° S.), 42 miles westsouthwest; 21.2 meters; May 30, 1911 [Gislén, 1919].

Mjöberg's station 3; Cape Jaubert, 45 miles westsouthwest; 21.2 meters; June 1, 1911 [Gislén, 1919].

Mjöberg's station 5; Cape Jaubert, 42 miles westsouthwest; 12.8 meters; July 5, 1911 [Gislén, 1919].

Mjöberg's station 12; Cape Jaubert, 45 miles westsouthwest; 20.1 meters; July 20, 1911 [Gislén, 1919].

Near Cape Voltaire, Western Australia (lat. 14° 50′ S., long. 125° 40′ E.) [A. H. Clark, 1911, 1913] (2, B. M.).

Baudin Island, Western Australia (lat. 14° 08′ S.) [Bell, 1894; A. H. Clark, 1911, 1913] (1, B. M.).

Baudin Island; 14.6—27.4 meters [Bell, 1894; A. H. Clark, 1911, 1913] (6 B. M.).

Holothuria Bank, northwestern Australia (lat. 13° 35′ S.) [Bell, 1894; A. H. Clark, 1911, 1913] (2, B. M.). Same, 43.8 meters [Bell, 1894; A. H. Clark, 1911, 1913] (5, B. M.). Same, 62.1 meters [Bell, 1894; A. H. Clark, 1911, 1913] (1, B. M.). Same, 65.8 meters [Bell, 1894; A. H. Clark, 1911, 1913] (2, B. M.).

Bassett-Smith Bank; 16.4 meters [Bell, 1894; A. H. Clark, 1911, 1913] (1, B. M.).

Northwestern Australia [P. H. Carpenter, 1888]. Same [Bell, 1894; A. H. Clark, 1911, 1913] (8, B. M.).

Northwestern Australia; 16.4 and 36.5–65.8 meters [A. H. Clark, 1911].

Northwestern Australia; 36.5–65.8 meters [Bell, 1894].

Alert; Dundas Strait, northwestern Australia, between the Coberg Peninsula and Melville Island; 31 meters; mud [Bell, 1884; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Alert; Arafura Sea [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

Australia (1, U.S.N.M., 36158).

Alert; Thursday Island [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (6, B. M.).

Alert; Thursday Island; 7.3–10.9 meters [Bell, 1884; A. H. Clark, 1911, 1913] (1, B. M.).

Thursday Island [Döderlein, 1898].

Friday Island [H. L. Clark, 1915, 1921]. Same, September, 1913 (1, M. C. Z., 558).

Alert; Prince of Wales Channel; 12.7 meters [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (2, B. M.).

Alert; Warrior Reef, Torres Strait [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

Mer, Murray Islands, Torres Strait [H. L. Clark, 1915, 1921] (3, M. C. Z., 516). Same, October, 1913 [H. L. Clark, 1915, 1921] (20, M. C. Z., 560, 563). Same, south reef; October 3, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 559).

Fitzroy Island [P. H. Carpenter, 1888; A. H. Clark, 1911].

Challenger; channel between Albany Island and Somerset, Cape York; 14.6–21.9 meters; September 7, 1874 (also given simply as Cape York) [P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

Albany Passage [A. H. Clark, 1911] (1, Austr. M.).

Cooktown, Queensland [Hartlaub, 1891; A. H. Clark, 1911].

Port Molle, Queensland [A. H. Clark, 1911] (2, U.S.N.M., 34951; Austr. M.).

Alert; Port Molle; 25.6 meters; rock [P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (3, B. M.).

Alert; Port Curtis; 0–20 meters; sand and shell [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

No locality [A. H. Clark, 1911, 1913] (7, B. M.; L. M.; Austr. M.).

Erroneous localities.—Port Jackson, New South Wales [A. H. Clark, 1911] (1, Austr. M.).

Sydney, New South Wales [A. H. Clark, 1911]; this is based on the same specimen as the preceding.

No locality; Péron and Lesueur, 1803 [P. H. Carpenter, 1882] (=*C. purpurea*).

No locality; Rennes Museum; [Dujardin and Hupé, 1862] (appears to be *A. mediterranea*).

Geographical range.—From the China Sea and Luzon southward to Port Curtis, Queensland (lat. 24° S.), and the Abrolhos Islands, Western Australia (lat. 28° 40′ S.), and westward to Ceylon.

Bathymetrical range.—From the shore line down to 73 (?292) meters. The average of 38 records is 41.6 meters. If the record of 292 meters, which seems questionable, be included the average of 39 records is 48.1 meters.

This species is especially abundant just below the low-tide mark and in the immediately adjacent sublittoral zone.

Thermal range.—There are no temperature records.

History.—The name *Asterias pectinata* was undoubtedly intended by Linné (1758) to apply to the common species of *Antedon* on the European coasts. The references he cites are the following:

Barrelier (Δεκάκνημος *fimbriata*).
Columna (δεκαδασυακτινοειδῆς).
Petiver (*Stella chinensis perelegens*).
Linck, Figure 64 (Δεκάκνημος *barbata*).
Linck, Figure 66 (Δεκάκνημος *rosacea*).

Barrelier's *fimbriata*, Linck's *barbata*, and Columna's δεκαδασυακτινοειδῆς all refer to *Antedon mediterranea.* Linck's *rosacea*, based upon Llhuyd's *Decempeda cornubiensium,* which is not mentioned by Linné, is *Antedon bifida.* Petiver's *Stella chinensis perelegens* is *Capillaster multiradiata.*

As the habitat of *Asterias pectinata*, Linné gave "in mare Indico," notwithstanding the fact that none of the references cited mention specimens from the Indian seas. The discrepancy is explained by the existence at Lund of the actual specimen which Linné had before him when he wrote the description. This is a representative of the form now known as *Comatula pectinata.*

In 1767 Linné added to the synonymy of *Asterias pectinata* Seba's *Stella marina polyactis*, seu *Luna marina* (with 29 arms), and his *Luna Marina altera* (with 37 arms). The former, from Mexico, is *Nemaster grandis*, but the latter, without locality, is unidentifiable.

In 1783 and again in 1805 A. J. Retzius published a careful redescription of the Linnean type. It was later studied by Johannes Müller, who published another redescription of it in 1843.

In his monograph of the recent comatulids published in 1849 Müller included *Asterias pectinata*, with a query, in the synonymy of *Comatula* (*Actinometra*) *solaris* and remarked that it seemed to be merely a color variety of the latter. He noted that, while the coloration of *pectinata* is very characteristic, its structural features are the same as those of *solaris*.

In the same memoir Müller described as a new species *Comatula cumingii* from Malacca.

Dujardin and Hupé in 1862 republished Müller's description of the Linnean type of *pectinata*, calling the species *Actinometra pectinata*. They stated that Müller had seen this species in the museum at Lund, where it had previously been described by Retzius. They remarked that they had found all the characters mentioned, except for the black dorsal lines and the arrangement of the ventral surface of the disk, in a much altered specimen in the old museum at Rennes which had come from the collection of President de Robien. The color of this specimen seemed to have been purple. The total expanse must have been about 234 mm. They added that in this case especially the characters furnished by the syzygies seem inconstant. From this last remark and from the fact that the *Stella* (*Decameros*) *barbata* of Linck is included in the synonymy of *pectinata*, and it is elsewhere mentioned that the two are identical, it seems most probable that the specimen referred to was an example of *Antedon mediterranea*. Dujardin and Hupé do not mention Müller's *Comatula cumingii*, and indeed appear never to have seen his elaborate memoir which was published in 1849. It is cited only in connection with those species which are therein described from specimens in the Paris Museum, and in no case is a page reference given. Their descriptions are all taken from Müller's earlier papers, published in 1841 and 1843.

In 1869 J. A. Herklots published a description by Kuhl and van Hasselt of a new species from Cape Bantam, Java, which was called *Comatula* (*Actinometra?*) *hamata*. Herklots said that although this new form approaches *Actinometra solaris* and *Asterias pectinata*, the details of its structure, that the manuscript notes of the travelers (Kuhl and van Hasselt) permitted him to indicate, seem sufficiently pronounced to distinguish it from the known species.

This form has heretofore been considered as a synonym of *Comatula solaris*, but the small number of cirrus segments (13–14) show that it really is a synonym of *C. pectinata*.

The form from near Bohol, Philippines, mentioned by von Graff in 1877 as a host for myzostomes under the name of *Actinometra solaris* is in reality this species. The identification of the specimens was made by Carpenter.

In his memoir on the genus *Actinometra* published in 1879 Carpenter determined *pectinata* as a species of that genus. In the earlier portion of this memoir it is evident that he is following Müller in considering *pectinata* as probably synonymous with *solaris*, and the specimens of the latter from the Philippines which he mentions really represent the former. But while the work was in press he seems to have become convinced of the distinctness of the two, for his references to the figures on the plates are segregated under the names *solaris*, *pectinata*, and *robusta*. He had not been able to examine *Comatula cumingii* and, being without information regarding the position of the mouth or the character of the oral pinnules, he could not definitely assign it either to *Actinometra* or to *Antedon*.

In 1881 Carpenter said that the *Challenger* in cruising from Cape York through the Banda and Arafura Seas to the Philippines and thence southward to the Admiralty Islands secured three species of 10-armed comasterids. One of these was *C. pectinata* and the other two were forms of *C. solaris*. He also stated that nearly all the 10-armed comasterids in the Eastern Hemisphere belong to the *solaris* type in which the elements of the IBr series and the first two brachials are united by syzygy, the only exceptions known to him being *Actinometra cumingii* and 2 or 3 undescribed species from China, Japan, and Sumatra.

In 1882 Carpenter, in his discussion of *Actinometra solaris*, noted that the specimens brought by Professor Semper from Bohol and referred by him in 1879 (and by von Graff in 1877) to *solaris* are in reality *pectinata*; he gave what he considered the essential characters of these, and also of the type specimen at Lund. He further mentioned some of the characters of a specimen from Java which he had seen in the Copenhagen Museum bearing the manuscript name *Actinometra affinis* Lütken. He also referred to a couple of small specimens in the Paris Museum from the voyage of Péron and Lesueur; these, however, are *purpurea* and not *pectinata*.

In another paper published in 1882 Carpenter included a specific formula for this species.

In 1884 Prof. F. Jeffrey Bell recorded under the name *Antedon irregularis*, *Actinometra solaris*, and *Actinometra*, sp. juv., a number of specimens taken by the *Alert* on the Australian coast which subsequently proved to be this species. In the same year Professor von Graff again mentioned the specimens from Bohol under the name of *solaris*, and in 1887 he mentioned some others from the Moluccas under the same name.

In the *Challenger* report on the comatulids (1888) Carpenter published a very detailed account of this species, which he carefully distinguished from *C. solaris*. He considered *Actinometra affinis* Lütken, MS., of which he had published a specific formula in 1883, as identical with *pectinata*, and *Actinometra purpurea* as probably a young form of the same type. He mentioned that in nearly all the specimens which he had examined the mouth is radial, and that some or all of the 4 posterior arms are very frequently ungrooved. He also noted that the disk may be very completely plated in some localities, as at Cape York and at Port Curtis, though it may be entirely membranous elsewhere, while the basal pinnules are much more uniformly carinate than they are in *C. solaris*. Among the localities he gave those cited by von Graff; but he said nothing about these, nor did he refer to von Graff in his synonymy. He also gave the localities represented by the specimens in the *Alert* collection, which he had studied at the British Museum, and included references to Bell's report in the synonymy.

Carpenter placed *Actinometra cumingi* not in the *Solaris* group with *pectinata* but in the *Echinoptera* group consisting of 10-armed species in which the elements of the IBr series are united by synarthry instead of by syzygy. He thus entirely overlooked the correspondence between *cumingii* and *pectinata.*

In 1891 Dr. Clemens Hartlaub recorded two specimens which had been collected by Dr. J. Brock at Amboina, another from the China Sea in the Göttingen Museum, and two from Cooktown in the Stuttgart Museum. In 1894 Prof. F. J. Bell recorded a number of specimens from northwestern Australia, in 1895 Prof. René Koehler recorded one from Billiton, in 1898 Prof. Ludwig Döderlein recorded the species from Thursday Island, and in 1900 Prof. Georg Pfeffer recorded it (as *Actinometra pectinata* and also as *Antedon cumingii*) from Ternate.

In the original description of *Comanthus* [*Comatulides*] *decameros* (1908) I compared it with *Comanthus cumingii* from the East Indies. This last was in reality the broad-armed form of *Comatula pectinata*, the specimens being those from the Philippines mentioned below.

In 1908 I recorded a number of examples of *pectinata* from two stations in the Philippines, and from the Philippines without locality. Individuals of the broad-armed type, misidentified as *Comanthus cumingii*, were also recorded from two stations. The two supposed species were compared in considerable detail, and it was mentioned that a specimen from Java identified by Carpenter was at hand for comparison. This specimen was the *Actinometra affinis* Lütken, MS., belonging to the Copenhagen Museum.

In 1909 I recorded a specimen from another *Albatross* station in the Philippines. In another paper I discussed at length the articulation between the elements of the IBr series and the first 2 brachials which I described as an exceedingly close synarthry and not a syzygy. In a third paper I gave a detailed description of the type specimen of *Actinometra affinis* from Java, at the same time recording and giving notes upon a large number of specimens from Singapore and calling attention to the curious dimorphism in the arms of this species, which is similar to that seen in the Caribbean *Comactinia echinoptera*. The possible bearing of the individuals with extremely long and attenuated arms on the systematic interpretation of *Uintacrinus* was discussed.

In a redescription of the type specimen of Müller's *Alecto purpurea* published in 1910 I considered in detail the relationship of *pectinata* with this form.

In 1911 I recorded some hitherto unnoticed specimens in the collection of the Australian Museum from Albany Passage and Port Molle, and others from Australia without definite locality. I also recorded one labeled Port Jackson. Various notes on the arm structure were given, and it was said that an examination of the type specimen of Müller's *Comatula cumingii* showed it to be a young individual of *pectinata.* In other papers I discussed in detail the distribution of this species on the Australian coasts, recorded specimens from two additional *Albatross* stations in the Philippines, and an example of the broad-armed type without locality in the Leyden Museum.

In 1912 I published notes on the specimens in the Berlin Museum, including the type of *Comatula cumingii*, and also gave a detailed account of the species in my memoir on the crinoids of the Indian Ocean.

In 1913 I published an account of the specimens in the British Museum, including a redetermination of all the material previously noticed by Bell, and in 1915 I again discussed the distribution of this form on the Australian coasts.

Dr. Hubert Lyman Clark in 1915 recorded this form from Mer, where it was decidedly uncommon though several specimens were taken, and also recorded a single example from Friday Island. In another paper he listed it from Ceylon on the strength of an indefinite record in my memoir on the crinoids of the Indian Ocean (1912).

In 1918 I recorded and gave notes upon specimens from 13 additional localities where they had been dredged by the *Siboga*.

In 1919 Dr. Torsten Gislén recorded and published notes upon specimens from a number of localities in northwestern Australia where they had been collected by Dr. Eric Mjöberg. In this memoir he gave reasons for regarding *purpurea* as merely a variety of *pectinata*.

In 1921 Dr. H. L. Clark republished his records of this species from Torres Straits and discussed the significance of its distribution in Australia. In 1923 he recorded the species from two localities in the Abrolhos Islands, giving notes on the specimens. He was inclined to agree with Gislén that the differences between *pectinata* and *purpurea* are certainly not specific.

In 1924 Gislén published various notes on the structure of this species.

COMATULA PURPUREA (J. Müller)

Plate 39, Figures 108, 109; Plate 40, Figure 111; Plate 41, Figure 114

[See also part 1, fig. 38 (syzygy), p. 75; fig. 79 (type specimen), p. 132; part 2, figs. 406–409 (pinnule tips), p. 250; figs. 622–625 (comb), p. 319; figs. 661, 662 (syzygy), p. 329]

Alecto purpurea J. Müller, Archiv f. Naturgesch., 1843, vol. 1, p. 132 (description; New Holland); Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 249 (perhaps young of *solaris*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 278 (probably a synonym of *pectinata*).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 23, 1910, p. 95 (redescribed from the type specimen and reinstated as a valid species of *Comatula* near *C. pectinata*); fig. p. 97; Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (history); p. 437 (northwest Australia, 20–36 fathoms; identification); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 711 (history; distinct from *Asterias pectinata*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 383 (identity).

Comatula purpurea Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 202 (synonymy; description; Australia).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position; probably a true *Actinometra*).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 23, 1910, p. 96 (redescription of the type specimen from New Holland; recorded from Queensland [in reality *Comanthus parvicirra*]; relationships with *C. pectinata*) Proc. U. S. Nat. Mus., vol. 39, 1911, p. 532 (arrangement of the cirri compared with that of *C. pectinata*); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 247 (no locality; 1 specimen in the Paris Mus.); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 440 (Australian tropical species occurring south to Port Denison and Perth); p. 443 (range on east coast); p. 444 (range on west coast); p. 451 (localities; summary of previous localities; descriptions of specimens); p. 465 (association with other species); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 717 (known to Carpenter from Australia); p. 718 (?recorded by Hartlaub, 1891, as *Actino-*

metra pectinata); p. 721 (occurs south to Port Denison and Shark Bay); p. 724 (peculiar to north Australia); p. 733 (in key); p. 745 (never more than 10 arms); p. 746 (annotated synonymy; characters; localities); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 20 (compared with *C. tenuicirra*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 5 (localities; descriptions); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 381 (specimens from Useless Inlet and Freycinet Reach, Shark Bay, in U.S.N.M.); p. 383 (=*Alecto purpurea* J. Müller, 1843); p. 384 (=*Actinometra purpurea* P. H. Carpenter, 1888); p. 389 (Australia; type of *Alecto purpurea;* southwest Australia); Crinoids of the Indian Ocean, 1912, p. 39 (=*Actinometra pectinata* Bell, 1894, part); p. 81 (synonymy; summary of previous records); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 307 (Houtman's Abrolhos; South Passage, Shark Bay, 9 m.; descriptions of specimens); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 9 (published references to specimens in the British Museum; localities represented; characters of the specimens); p. 75 (=*Actinometra alternans* Bell, 1884, part).—Reichensperger, Abhandl. Senck. naturforsch. Gesellsch., vol. 35, Heft 1, 1913, p. 82 (Aru Is.); p. 86 (details of localities; notes).—A. H. Clark, Records W. Australian Mus., vol. 1, 1914, p. 120 (between Fremantle and Geraldton; notes); Internat. Revue d. gesamt. Hydrobiol u. Hydrogr., 1915, p. 224 (detailed account of the distribution in Australia).—H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 101 (exceedingly common at Mer; very variable); pp. 107 and following (habits and reactions); p. 109 (breeding season).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 233 (southwest Australia, Nos. 5961–64; Western Australia, No. 6134).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, pp. 271–276 (listed); pl. 14, fig. 16 (4-rayed specimen).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 3 (variety of *C. pectinata*); p. 6 (information on the specimens given under *C. pectinata* var. *purpurea*); p. 7 (discussion).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 6 (history); p. 8 (secured by the Carnegie Exped.); p. 14 (range; exceedingly common at Mer; notes; reactions; color); p. 116 (host of *Ophiomaza cacaotica*); pp. 192 and following (range).

Actinometra purpurea P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 386; Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 278 (probably a synonym of *pectinata*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity of type).

Comatula simplex (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 28 (the 2 specimens referred to as *pectinata*).

Actinometra pectinata P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 28 (the 2 specimens in the P. M. labeled *simplex*).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 165 (Dundas Strait).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 284 (part); p. 314.—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 9 (B.M., MS.; Torres Straits; Dundas Strait; no locality).

Actinometra solaris (part) Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 165 (Torres Straits).

Actinometra alternans (part) Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 169 (Port Molle).

Comatula (*Comatula*) *purpurea* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 27 (in key; range; synonymy; notes; stations 37, 49*a*, 61, 99, 144, 250, 273, 274, 282, 285, 299, 301, 303, 318).

Comatula pectinata var. *purpurea* Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919 p. 3 (discussion); p. 5 (Mjöberg's stations 1, 2, 12, 14); p. 6 (synonymy; detailed descriptions and notes); pl. 1, fig. 2.—H. L. Clark, Records Australian Mus., vol. 15, No. 2, Nov. 18, 1926, p. 183 (Great Barrier Reef; notes).

Diagnostic features.—Except for having the cirri wholly confined to the interradial angles of the centrodorsal, one or two being present in each interradius, this species agrees with *C. pectinata.* It differs from *C. tenuicirra*, in which the cirri are similarly segregated in the interradial angles, in having the longest cirrus segments little, if at all, longer than broad.

Description of the type specimen.—The centrodorsal is a small thin disk with the slightly concave dorsal pole about 1 mm. in diameter.

The cirri are IX, segregated on the interradial angles of the centrodorsal in 4 pairs, the remaining angle having a single one. The cirri are all broken. Ten stumps remain of which the longest is 5.5 mm. long and consists of 10 segments of which the first is short and the remainder are about one-third again as broad as long.

The radials are very short, just appearing beyond the centrodorsal. The elements of the IBr series are very closely united, externally appearing as if by syzygy. The IBr series as a unit are broadly pentagonal, twice as broad as long. The IBr_1 are laterally united. The IBr_2 (axillaries) are triangular, with the lateral angles not in apposition.

The 10 arms are 70 mm. long. The first 2 brachials are united by what appears to be a perfect syzygy, forming a wedge-shaped pair which is about twice as broad as long in the median line. The first brachial is short, with the proximal and distal edges parallel, and the second is triangular, twice as broad as the exterior length. The third and fourth brachials form a short and nearly oblong syzygial pair which is about twice as broad as its maximum length. The following 3 brachials are short, slightly wedge-shaped, nearly three times as broad as long, and those succeeding become triangular, twice as broad as long, with the distal edge slightly concave and the outer side slightly convex. The brachials gradually increase in length distally and in the outer part of the arm become wedge-shaped, and distally about as long as broad. In the median line of the dorsal surface of the arm there runs a narrow low rounded carination which is rather prominent and is continued to the arm tip. The arms increase slightly and gradually in width to the twelfth or fourteenth brachials, thence tapering slowly distally.

Syzygies occur between brachials 1+2 and 3+4, again from between brachials 11+12 to between brachials 13+14 (usually in the latter position) and between brachials 16+17 or 17+18 (usually in the latter position), and distally at intervals of from 3 to 5 (usually 4) muscular articulations.

The pinnules resemble those of *Comatula pectinata*. The second segment of the second and third pinnules is more or less enlarged and carinate dorsally, this feature being most marked on P_2; the third segment is similarly, but much less noticeably, modified.

The color in alcohol is deep purple.

Notes.—The 2 specimens from *Siboga* station 99 are both small with the arms 30 mm. long and the cirri X, arranged in 5 interradial pairs.

The specimen from the Danish expedition to the Kei Islands station 67 is typical; the cirri are X, in 5 interradial pairs.

The specimen from *Siboga* station 144 is small with the arms 45 mm. long and V cirri; the interradial areas of the disk proximal to P_1 are thickly studded with calcareous deposits.

The larger specimen from *Siboga* station 318 has 11 arms 125 mm. in length; the cirri are VI, 4 of them grouped in 2 interradial pairs and 2 occurring singly. The arms are of the slender type and, except for the characteristic arrangement of the cirri, the animal bears a close resemblance to that upon which Lütken based the name *affinis* (see under *pectinata*). The smaller example has 10 arms 85 mm. long; the cirri are VIII, 2 occurring singly and the others in 3 interradial pairs.

The specimen from *Siboga* station 37 is a typical example with the arms 55 mm. long.

From *Siboga* station 49*a* there are 3 small specimens of which the largest has the arms 25 mm. long and the cirri VI.

From *Siboga* station 61 there is a small example with the arms 25 mm. long.

The largest specimen from *Siboga* station 299 has the arms 45 mm. long and the cirri V. Three others have the arms 40 mm. long and the cirri III, V, and VIII. Another has the arms 35 mm. long and the cirri V.

A small example from *Siboga* station 301 has the arms about 40 mm. long and the cirri IX, two of the last being very small.

The largest individual from the reef at Haingsisi (*Siboga* station 303) has the anterior arms 85 mm. long and the posterior arms 50 mm. long. The cirri are II, but there are sockets for four more. Another has the anterior arms 80 mm. long and the posterior 45 mm.; the cirri are III. The two additional specimens are small.

The specimens from *Siboga* station 285 are both small.

The largest example from *Siboga* station 282 has the arms 60 mm. long and the cirri II. Four have the arms 45 mm. long and the cirri III, III, IV and VIII. One has the arms 30 mm. long and the cirri VI. There are 18 others. In another lot from the same station there are 17 specimens with the arms ranging from 12 to 40 mm. in length; most of them have V cirri, one in each interradial angle; the smallest has VI cirri arranged in two interradial pairs with two occurring individually, one of the interradial angles being vacant.

From *Siboga* station 250 there is a small example with arm 35 mm. long; the cirri are IX, very slender. The disk has been lost but the interradial areas proximal to the bases of P_1 are filled with a strong calcareous webbing.

The two specimens from *Siboga* station 274 are large, and have the arms moderately swollen.

From *Siboga* station 273 there is a specimen with the arms about 70 mm. long, 4 of them ungrooved; the cirri are VII. Another individual has the arms about 55 mm. long, and stout; 5 of the arms are grooved and 5 are ungrooved; the cirri are VII, arranged in 2 interradial pairs with 3 occurring individually; the disk is regenerating, and the course of the digestive tube is shown by a broad spiral about the anal cone. Two specimens have the anterior arms 55 mm. long and the posterior 35 mm. long; 4 of the arms are ungrooved and 6 are grooved; the cirri are V, there being a single one in each interradial angle, in one of the specimens, while in the other they are IV, one of the interradial angles being vacant. A specimen with the arms 50 mm. long has the cirri VI, 4 arranged in 2 interradial pairs and 2 occurring singly, with 1 of the interradial angles vacant. Another specimen has the anterior arms 50 mm. long and the posterior 30 mm. long; there are 4 ungrooved and 6 grooved arms; the cirri are V, 1 in each interradial angle. A small specimen has the arms 30 mm. long and the cirri V. A still smaller individual has the arms 15 mm. long and the cirri VIII, arranged in 2 interradial pairs with 3 occurring singly.

The 2 specimens from near Udjir, Aru Islands, described by Reichensperger are large with the arms strongly swollen and with a prominent median keel. In 1 the length of the 5 grooved arms is almost 150 mm., that of the 5 ungrooved arms being about 120 mm. The cirri are VII, 11–12, four arranged in two interradial pairs and the other three occurring singly. In the other the length of the 5 grooved arms is 90 mm., and that of the 5 ungrooved arms 50 mm. The cirri are VII, 11, 6 mm. long, arranged as in the other. The lower pinnules are scarcely keeled. The color of both is brownish.

As described by Reichensperger the single specimen from Dobo Strait is small with the 6 grooved arms 70 mm. long and the 4 ungrooved arms 45 and 50 mm. long. The centrodorsal is somewhat projecting, small and rounded. The cirri are VIII, 11–13, 5.5 mm. long. Six of the cirri are arranged in three interradial pairs, the other two occurring singly. The arms are somewhat swollen. A faint light median keel runs along the dorsal surface of the brachials. P_2 has the basal segments often prominently keeled.

Of the 4 specimens dredged by the *Endeavour* between Fremantle and Geraldton, 1 is typical with VIII cirri, 6 occurring in 3 interradial pairs and 2 singly. Another has XI cirri. The cirri in the other 2 are more numerous than usual, but are evidently undergoing reduction toward the condition normal for the species—indeed in the larger the normal arrangement occurs on about four-fifths of the periphery of the centrodorsal. In the largest specimen the anterior arms are about 100 mm. long.

One of the specimens presumably from the vicinity of Perth has the anterior arms 100 mm. long and the posterior arms 60 mm. long. There are 5 grooved and 5 ungrooved arms. The other specimen is somewhat smaller. The carination is almost obsolete on the IBr series. The cirri are XIV, arranged in 5 interradial pairs with 4 extra, 2 of which are only partially developed. The color is light olive brown, the centrodorsal, calyx and first 2 brachials being rose colored.

Of the 2 specimens from the Abrolhos Islands, 1 has the anterior arms 120 mm. long and the posterior arms 60 mm. long. The cirri are VIII, 14–15, and are of the stout type although the arms are only very slightly broadened. The color is a very light brown, with the centrodorsal and most of the IBr series rose pink. The other specimen differs only in having the cirri slightly more slender, XIII in number.

The specimen from the Hamburg southwest Australia expedition station 15 has the anterior arms 120 mm. long and the posterior arms 90 mm. in length. The joint surfaces of the articulation between the first 2 brachials are practically indistinguishable from those of a typical syzygy. This articulation is very brittle, as in the type specimen which this very closely resembles except for its larger size. The arms are slightly swollen. The ossicles of the IBr series and the brachials have a fine narrow mediodorsal ridge running the entire length of the arm as is usual in this species. The cirri are V, 11–13, from 8 mm. to 9 mm. in length.

Of the 2 specimens from the Hamburg southwest Australia expedition station 26, one has the anterior arms 90 mm. long and the posterior arms 70 mm. long. All the arms are grooved, but the first 10 pairs of pinnules on the posterior and the first 6 on the anterior arms are ungrooved. The brachial carination resembles that in the other specimens. The cirri are X, 12, from 6 mm. to 7 mm. in length.

One of the specimens from the Hamburg southwest Australia expedition station 19 has the anterior arms 160 mm. long and the posterior arms 85 mm. long. This is a fine large specimen, typical of the species, with the usual type of small weak cirri. There is a prominent very narrow median carination running the entire length of the arms and also occurring on the elements of the IBr series. The anterior arms are slender and elongate, the posterior being scarcely more than half as long and somewhat swollen in the proximal half. Four of the arms have no ambulacral grooves at all, and in the other 6 only the distal pinnules are supplied with them. The cirri are IX, 12, 7 mm. long. The color is light yellow brown. A second specimen has the anterior arms 135 mm. long and the posterior arms 70 mm. long. Two of the arms are ungrooved, and the genital pinnules on the others lack grooves. The cirri are IV, 10–12, 7 mm. long. The color is light yellow brown. The third specimen has the anterior arms 110 mm. long and the posterior arms 80 mm. long. The arms have the same mediodorsal carination as in the other specimens. Three arms are wholly ungrooved, one has a partially obliterated ambulacral groove, while on the anterior arms all the pinnules beyond the fifth or sixth pair are grooved. The cirri are VII, 10–11, from 5 mm. to 7 mm. long.

Of the specimens from the Hamburg southwest Australia expedition station 14, one has the anterior arms 125 mm. long and the posterior arms 70 mm. in length. The cirri are VII, 12–14, from 10 mm. to 12 mm. in length; they are arranged in 2 pairs with 3 occurring singly. Four of the arms are ungrooved, and there are no grooves on the genital pinnules of the others. A fine mediodorsal carination is present on the ossicles of the IBr series and on the brachials. A second specimen has the anterior arms 130 mm. long and the posterior arms 95 mm. in length. Four entire arms and the genital pinnules of the other 6 are ungrooved. The cirri are VII, as in the other. The third specimen is similar to the first.

One of the specimens from the Hamburg southwest Australia expedition station 21 has the anterior arms 140 mm. and the posterior 80 mm. in length. The usual fine dorsal carination is present. The posterior arms are slightly swollen, the anterior being more slender. Three entire arms and the genital pinnules on all the others are ungrooved. The cirri are small, IX, 11–12. The other specimen is smaller, the anterior arms being 100 mm. long and the posterior 55 mm. The posterior arms are slightly stouter than the anterior. The cirri are VIII, 11–13, from 4 mm. to 7.5 mm. long.

The specimen from the Hamburg southwest Australia expedition station 23 has the anterior arms 70 mm. long. The cirri are IX, one being unpaired, and robust.

The specimen from Turtle Island, Western Australia, has the arms 130 mm. in length. There is a fine carination along the mediodorsal line of the IBr series and the brachials. The cirri are X, 13, comparatively large, from 10 mm. to 11 mm. long, and are arranged in 5 pairs.

According to Gislén the specimens from near Cape Jaubert had the cirri VI–IX, and the combs on P_1 consist of 10–15 teeth. Three of these specimens represent typical *purpurea*. One from Mjöberg's station 2 has the cirri IX, 11–12 (young cirri with 10 segments); the anterior arms are 40 mm. and the posterior 25 mm. in length. Another from Mjöberg's station 12 is a typical *purpurea* with the cirri IV, 10–11. The third typical *purpurea* is from Mjöberg's station 14; the cirri are IX, 9–11. Four other specimens are intermediate between *purpurea* and *pectinata*. One of these, from Mjöberg's station 3, has the cirri XI, 11–12; empty cirrus sockets occur radially on the centrodorsal. In another, from Mjöberg's station 5, the cirri are X, 10–13; on three-fifths of the periphery of the centrodorsal the cirrus sockets have the *purpurea* arrangement, but on the remaining two-fifths they are irregularly placed. In a specimen from Mjöberg's station 12 the cirri are XVIII, 10–12, with the *purpurea* arrangement on two-fifths of the periphery of the centrodorsal. In another from the same station the cirri are XII, 11–13, with the *purpurea* arrangement on two-fifths of the periphery of the centrodorsal; 2 of the cirri are small, 1 of these being on either side of a larger cirrus radially placed.

The 2 specimens from Dundas Strait collected by the *Alert* and the 1 from Dimes Island, New Guinea, in the British Museum are small.

In the 13 specimens from the Murray Islands in the collection of the Australian Museum, the cirri are V–X (usually nearer the latter), 9–12 (usually 11–12), 6 mm. long. As in *C. pectinata* the cirri are of two types which are quite distinct, a generalized type in which the segments, except the basal two, are subequal in length and the distal are not compressed laterally, and a more specialized type in which the distal segments are shorter than the proximal and are laterally compressed. The arms are from 40 to 50 mm. in length. The mediodorsal line from the sixth brachial outward is occupied by a delicate narrow rounded ridge which is more prominent than the similar ridge often seen in *C. pectinata.*

Of this species as he found it at Mer in the Murray Islands Dr. Hubert Lyman Clark said that the adults are readily distinguishable from individuals of *pectinata* of the same size by the characteristic number and arrangement of the cirri. He saw no specimen that could not promptly be assigned to one species or the other by this feature alone, but he failed to find any other difference between *purpurea* and *pectinata*, and does not feel at all certain that they are really distinct. The fact that specimens of *pectinata*, large and small, were found at Mer associated with *purpurea* and distinguishable only by their more numerous and more continuously arranged cirri made him somewhat skeptical. Some of the largest specimens of *purpurea* lack cirri altogether, but the sockets, usually paired, sometimes single, at the five corners only of the centrodorsal are unmistakable.

The 2 specimens from off Ellison reef are rather large, with the anterior arms 125 mm. long. Dr. H. L. Clark says that they look like *pectinata*, but have the cirri as in *purpurea.*

The specimen from the outer Great Barrier reef is smaller than the preceding, quite stout, with all the arms subequal. The cirri are II. The color is a bright orange brown (rust color), but Doctor Clark says that this coloration has the appearance of being artificial.

The specimen from Port Denison has the arms 80 mm. long and the cirri VIII, 10–12, from 8 to 10 mm. long.

The example without locality in the Australian Museum has the arms 120 mm. long and the cirri VII, 14–15, from 9 to 11 mm. long.

Abnormal specimens.—A 4-rayed specimen from *Siboga* station 273 has the anterior arms 70 mm. long and the posterior arms 45 mm. long. The cirri are VI, four arranged in two interradial pairs and the others occurring singly. The anterior ray is missing. The mouth is slightly to the left of the base of the left derivative from the ray just to the right of it. The arm at the left of the mouth and the 3 to the right are grooved, and the other 4 are ungrooved.

A specimen with 11 arms was taken at *Siboga* station 318.

Localities.—Albatross station 5276; China Sea, in the vicinity of southern Luzon; Malavatuan Island (NW.) bearing N. 61° 30′ E., 6.5 miles distant (lat. 13° 49′ 15″ N., long. 120° 14′ 45″ E.); 33 meters; shells, pebbles, and sand; July 17, 1908 (1, U.S.N.M., 34904).

Albatross station 5432; in the vicinity of eastern Palawan; Corandagos Island (NW.) bearing N. 30° E., 5.7 miles distant (lat. 10° 37′ 50″ N., long. 120° 12′ 00″ E.); 93 meters; sand; April 8, 1909 (1, U.S.N.M., 35885).

Siboga station 99; anchorage off North Ubian (lat. 6° 07′ 30″ N., long. 120° 26′ 00″ E.); 16–23 meters; lithothamnion bottom; June 28, 29–30, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Singapore; Svend Gad (1, U.S.N.M., E. 1085).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 67; Java Sea, off the western end of Java (lat. 5° 48′ N., long. 106° 12′ E.); 38 meters; sand and shells; July 27, 1922 (1). Pl. 41, fig. 114.

Siboga station 144; north of Salomakieë (Damar) Island, Anambas group; 45 meters; coral bottom with lithothamnion; August 7–9, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 318; northeast of Madoera (lat. 6° 36′ 30″ S., long. 114° 55′ 30″ E.); 88 meters; fine yellowish gray mud; February 22, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 37; Sailus ketjil, Paternoster Islands, north of Sumbava; 27 meters and less; coral and coral sand; March 30–31, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 49*a;* Sapeh Strait, between Sumbava and Komodo (lat. 8° 23′ 30″ S., long. 119° 04′ 36″ E.); 69 meters; coral and shells; April 14, 1899 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Siboga station 61; Lamakwera, Solor Island (east of Flores); 20 meters; coral and sand; May 1–2, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 299; Boeka, or Cyrus, Bay, southern coast of Rotti Island (lat. 10° 52′ 23″ S., long. 123° 01′ 06″ E.); down to 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (14, Amsterdam Mus.).

Siboga station 301; Papela Bay, eastern coast of Rotti Island (lat. 10° 38′ 00″ S., long. 123° 25′ 12″ E.); 22 meters; mud, coral, and lithothamnion; January 30, [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 303; Haingsisi, Samau Island; down to 36 meters; lithothamnion; February 2–5, 1900 [A. H. Clark, 1918] (4, Amsterdam Mus.).

Siboga station 285; anchorage on the southern coast of Timor (lat. 8° 39′ 06″ S., long. 127° 04′ 24″ E.); 34 meters; on the border between coral and mud; lithothamnion; January 18, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (41, Amsterdam Mus.).

Siboga station 250; anchorage off Kilsuin, western coast of Kur Island; 20–45 meters; coral and lithothamnion; December 6–7, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 274; between the Aru Islands and New Guinea (lat. 5° 28′ 12″ S., long. 134° 53′ 54″ E.); 57 meters; sand and shells; stones; December 26, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands (pearl banks); 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (25 U.S.N.M., E. 460; Amsterdam Mus.). Pl. 39, fig. 109.

Near Udjir, Aru Islands; 10–14 meters; coral rock and sand; Dr. H. Merton, April 16, 1908 [Reichensperger, 1913].

Dobo Strait, Aru Islands; 12 meters; coral rock; March 22, 1908 [Reichensperger, 1913].

Endeavour; between Fremantle and Geraldton, Western Australia [A. H. Clark, 1914] (4, U.S.N.M., 34930; W. A. M.).

Hamburg Western Australia expedition; ?Vicinity of Perth [A. H. Clark, 1911] (2).

Abrolhos Islands (Houtman's rocks), Western Australia [A. H. Clark, 1912] (2, H. M.). Same [A. H. Clark, 1913] (2, W. A. M.).

Hamburg Western Australia expedition station 15; Shark Bay, northnortheast of the northern point of Heirisson Prong; 11–12.5 meters; rocky bottom, with coral; June 18, 1905 [A. H. Clark, 1911] (1).

Hamburg Western Australia expedition station 26; Sunday Island, Shark Bay; 5.5 meters; bottom rocky, with coral; June 17, 1905 [A. H. Clark, 1911] (2).

Hamburg Western Australia expedition station 19; central channel of Useless Inlet, Shark Bay; 7 meters; bottom rocky, with dead coral; September 13, 1905 [A. H. Clark, 1911] (3).

Hamburg Western Australia expedition station 14; Freycinet Reach, Shark Bay, from west of middle flat as far as the northern point of Heirisson Prong; 11–16 meters; bottom at first sandy, later rock with coral; September 12, 1905 [A. H. Clark, 1911] (3, U.S.N.M., 34926). Pl. 40, fig. 111.

Hamburg Western Australia expedition station 21; Useless Inlet, Shark Bay, central channel and pearl banks; August 23–30, 1905 [A. H. Clark, 1911] (2 U.S.N.M., 34927).

Hamburg Western Australia expedition station 23; South Passage, Shark Bay; 9 meters; June 16, 1905 [A. H. Clark, 1913] (1, Berl. M., 6134). Same [A. H. Clark, 1912] (1, H. M.).

Southwestern Australia (refers to the specimens collected by the Hamburg Western Australia expedition in 1905) [A. H. Clark, 1912; Hartmeyer, 1916] (14, Berl. M., 5961–5964).

Turtle Island, off Larrey Point, Western Australia (lat. 19° 54′ S., long. 118° 54′ E.); July 1905 [A. H. Clark, 1911] (1).

Mjöberg's station 14; Cape Jaubert, 45 miles westsouthwest; 24.3 meters; July 29, 1911 [Gislén, 1919].

Mjöberg's station 12; Cape Jaubert, 45 miles westsouthwest; 20 meters; July 20, 1911 [Gislén, 1919].

Mjöberg's station 5; Cape Jaubert, 42 miles westsouthwest; 12.7 meters; July 5, 1911 [Gislén, 1919].

Mjöberg's station 2; Cape Jaubert, 42 miles westsouthwest; 21.3 meters; May 30, 1911 [Gislén, 1919].

Alert; Dundas Strait, between Melville Island and the Coburg peninsula, northwestern Australia; 31 meters; mud [Bell, 1884; A. H. Clark, 1913] (2, B. M.).

Dimes Island, New Guinea [A. H. Clark, 1913] (1, B. M.).

Murray Island, Torres Straits [A. H. Clark, 1911] (13 U.S.N.M., 36157; Austr. M.).

Mer, Murray Islands, Torres Straits; H. L. Clark, October, 1913 [H. L. Clark, 1915, 1921] (226, M. C. Z., 561, 562, 564–566). Same, western reef, near the northern end; September 24–26, 1913 [H. L. Clark, 1915, 1921] (20, M. C. Z., 519). Same, southeastern reef [H. L. Clark, 1915, 1921] (25, M. C. Z., 518). Same, south reef; September 29–30, 1913 [H. L. Clark, 1915, 1921] (8, M. C. Z., 517).

Alert; Torres Straits [Bell, 1884; A. H. Clark, 1913] (1, B. M.).

Off Ellison reef, outer Great Barrier reef, Queensland; 9–27 meters; Surg. Lieut. Comdr. W. E. J. Paradice, R. A. N., August, 1924; H. M. S. *Geranium* [H. L. Clark, 1926].

Outer Great Barrier reef, between lat. 17° and 19° S.; exposed reefs at low tide; Surg. Lieut. Comdr. W. E. J. Paradice, R. A. N.; 1924; H. M. S. *Geranium* [H. L. Clark, 1926].

Port Denison, Queensland [A. H. Clark, 1911] (1, U.S.N.M., 36156).

Australia (probably Western Australia); Preiss [J. Müller, 1843, 1849; P. H. Carpenter, 1888; Dujardin and Hupé, 1862; A. H. Clark, 1910, 1912] (1, Berl. M., 1049). Pl. 39, fig. 108.

Australia; Péron and Lesueur, 1803 [P. H. Carpenter, 1879; A. H. Clark, 1911] (1, P. M.). Same [A. H. Clark, 1913] (1, B. M.).

No locality [A. H. Clark, 1911] (1, Austr. M.). Same [A. H. Clark, 1913] (1, B. M.).

Erroneous locality.—Northwestern Australia; 36–66 meters [A. H. Clark, 1911].

Geographical range.—From the Philippines, the China Sea, and Singapore to Australia, southward to between Fremantle and Geraldton, Western Australia, and Port Molle, Queensland.

Bathymetrical range.—From the shore line down to 93 meters; the average of 29 records is 27.1 meters. This species is especially characteristic of the region just below the low-water mark and the immediately adjacent sublittoral zone.

Occurrence.—Dr. Hubert Lyman Clark noted that this species is exceedingly common at Mer, in the Murray Islands, in all sorts of situations, some of which are quite unlikely places for a comatulid. It was first noted among seaweed and rocks at the edge of the reef flat near the northern corner of the island on the west side. The individuals found here, where conditions seemed unfavorable to echinoderms and few occurred, were all small, rarely more than 90 mm. across when fully expanded, and in ordinary light seemed to be black. Some when critically examined in bright light were found to have a distinctly greenish cast, while others were brownish.

In a solution of Epsom salts ($MgSO_4$) in which they were placed for narcotization, they gave out rapidly and copiously a brownish red color. As the color was given out to an unequal degree, preserved specimens show much diversity of shade.

At first these small individuals from the northwestern reef were supposed to be young, but Doctor Clark says the very dark color suggests that they are adults stunted by the adverse conditions under which they live.

On the eastern and southern reefs *purpurea* proved to be very common and here reached a larger size. The largest ones found were about 250 mm. across.

Under the very favorable living conditions on these reefs great diversity of color was shown, especially among the smaller individuals; some were bright red, some madder red, some simply reddish, and occasionally one was yellowish olive, yellowish brown, or gray. Sometimes there were white stripes on the arms and pinnules, and the joints of the pinnules were white, but as a rule individuals were of uniform color.

History.—This species was first described by Johannes Müller in 1843. In his original description he made no mention of the segregation of the cirri in the interradial angles of the centrodorsal, simply saying that they are XII, 12, with the segments as broad as long.

The locality given by Müller was New Holland, a geographical term which at that time was used for the northwestern coast of Australia, or as an equivalent of Western Australia, rarely referreing to Australia as a whole.

In his monograph on the comatulids published in 1849 Müller said that *purpurea* differs from *solaris* only in the number of the radials of which 2, united by syzygy, are visible, and suggested that this difference may be due to age, *purpurea* being perhaps a young form of *solaris.*

Dujardin and Hupé in 1862 gave a translation of Müller's original description, without any reference to his final disposition of the form in 1849.

In 1879 Carpenter mentioned *Actinometra purpurea* in his preliminary account of the crinoids collected by the *Challenger*, and in his memoir on the genus *Actinometra* (the comasterids) published in the same year he remarked that he had not personally examined *purpurea*, but as Müller seemed to think that it might be a young condition of *solaris* it was most probably a true *Actinometra.* At the same time he mentioned having seen in the Paris Museum two specimens from the voyage of Péron and Lesueur in 1803 labeled *Comatula simplex* which represent *Actinometra pectinata.* I examined one of these in 1910 and found it to be an example of *Comatula purpurea.*

In 1883 Carpenter listed *Actinometra purpurea* with a specific formula, and in 1884 Bell recorded a number of specimens from northern and northeastern Australia under the names *Actinometra solaris, Act. pectinata* and *Act. alternans.*

In 1888 Carpenter noted that Müller regarded *purpurea* as probably a young form of *solaris;* but as both the Paris (*solaris*) and Vienna (*imperialis*) specimens of the latter have 20 cirrus segments while Müller described *Alecto purpurea* as having only 12 it should probably be referred to *pectinata.* In his discussion of *Actinometra* *pectinata* he inserted the reference to Müller's original description of *purpurea* without comment.

Thanks to the kindness of Drs. W. Weltner and R. Hartmeyer, of the Berlin Museum, I was enabled to examine the type of Müller's *Alecto purpurea*, and in 1910 I published a redescription of it accompanied by a figure, recognizing it as a valid species near *Comatula pectinata*.

In a memoir on the crinoids of southwestern Australia, published in 1911, based upon the collection made by the Hamburg southwest Australia Expedition in 1905, I recorded and gave notes on a number of specimens, and also gave a detailed account of the occurrence of the species on the Australian coasts. In the same year in a monograph on the crinoids of Australia I recorded and gave notes on others from Queensland in the collection of the Australian Museum. In another paper I mentioned the specimen in the Paris Museum from the voyage of Péron and Lesueur in 1803.

In 1912 I recorded the specimens in the Berlin Museum, which include Müller's original type and many of those from the Hamburg southwest Australia expedition which I had described in the previous year. I also recorded those in the Hamburg Museum, including some from the Abrolhos and others from the Hamburg southwest Australia expedition. In my monograph on the crinoids of the Indian Ocean I gave the geographical and bathymetrical distribution of this form.

In 1913 I recorded and gave notes upon additional specimens from the collection of the Hamburg southwest Australia expedition, and also recorded the specimens in the British Museum. In the same year Reichensperger recorded and described some specimens which had been collected by Dr. H. Merton in the Aru Islands in 1908.

In 1914 I recorded some specimens which had been collected by the *Endeavour* on the coasts of southwestern Australia, and in 1915 I discussed the distribution of this form on the Australian coasts.

It was in 1915 that Dr. Hubert Lyman Clark published his detailed account of the occurrence, habits, and reactions of this species as he found it in the Murray Islands, Torres Strait, in 1913.

In 1918 I gave a description of the numerous specimens which had been collected by the *Siboga* mostly in the Dutch East Indies in 1899–1900, and in 1919 Dr. Torsten Gislén described the material which had been collected in northwestern Australia by Dr. Eric Mjöberg in 1911.

Gislén found a number of specimens which were intermediate in their characters between *pectinata* and *purpurea*, and therefore treated the latter as a variety of the former.

In 1921 Dr. H. L. Clark gave a detailed account of this species in connection with his work on the echinoderm fauna of Torres Strait, and in 1923 he remarked that the differences between *purpurea* and *pectinata* are certainly not specific.

In 1926 Doctor Clark recorded and published notes upon 3 specimens from the Great Barrier reef which had been collected by Mr. W. E. J. Paradice, the surgeon of the *Geranium*, a sloop of the Royal Australian Navy, which had been engaged in Great Barrier reef investigations in 1924. At the same time he remarked that he believed Gislén to be right in his decision that *Comatula purpurea* is only a form or variety of *C. pectinata,* but that the 3 specimens in the present collection throw little light on the question.

COMATULA TENUICIRRA A. H. Clark

Plate 39, Figure 110

Comatula tenuicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 20 (description; *Siboga* station 320); A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. viii (discovery by the *Siboga* and its significance); p. 276 (listed); pl. 15, figs. 19, 20.

Comatula (*Comatula*) *tenuicirra* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 27 (in key; range); p. 29 (references; detailed description; station 320).

Diagnostic features.—The cirri are confined to the interradial angles of the centrodorsal, where they occur singly or in pairs as in *C. purpurea.* The longest cirrus segments are twice as long as broad instead of being little, if at all, longer than broad as in *C. purpurea.*

Description.—The centrodorsal is as in *C. purpurea.*

The cirri are V–IX, 14–15, from 13 to 15 mm. in length, occurring singly or in pairs in the interradial angles. The first segment is short, the second is nearly as long as broad, the third is from one-third to one-half again as long as broad, and the fourth and fifth are twice as long as the median width. The following segments gradually become slightly shorter so that the third before the antepenultimate is about one-third again as long as broad, the next is slightly longer, the antepenultimate is half again as long as broad, and the penultimate is very slightly longer than broad. The cirri are very slender, and are of the same type as the slender form of cirri found in *C. purpurea* and in *C. pectinata.*

The 10 arms are from 80 to 125 mm. in length in the larger specimens; they resemble the arms in the slender-armed form of *C. purpurea.*

The second and third segments of the proximal pinnules are very strongly carinate.

Notes.—Except for the longer and more slender cirri this form exactly resembles the slender armed variety of *Comatula purpurea.*

Of the additional specimens examined, one has the arms 80 mm. long and the cirri V. Another has the arms 55 mm. long and the cirri VII. A third has the arms 50 mm. long and the cirri IV. Two others have the arms 40 mm. and 35 mm. long and the cirri V. The remaining two are small. The cirri of these small examples are extremely delicate. The color is yellow brown. Some of the specimens have a stripe of dull purple on either side of the median dorsal line, and one has in addition a spot of purple on each of the pinnule segments.

Localities.—*Siboga* station 320; Java Sea, north of the eastern end of Madoera (lat. 6° 05′ 00″ S., long. 114° 07′ 00″ E.); 82 meters; fine gray mud; February 23, 1900 [A. H. Clark, 1912, 1918] (8, U.S.N.M., E. 401; Amsterdam Mus.). Pl. 39, fig. 110.

Siboga station 318; northeast of Madoera (lat. 6° 36′ 30″ S., long. 114° 55′ 30″ E.); 88 meters; fine yellowish gray mud; February 22, 1900 (5, U.S.N.M., E. 470).

Remarks.—This species has not been found since the original specimens were collected by the Dutch steamer *Siboga* in 1900.

COMATULA MICRASTER A. H. Clark

Plate 41, Figures 112, 113, 115-124

[See also vol. 1, pt. 1, fig. 39 (syzygy), p. 75; pt. 2, figs. 15, 16 (centrodorsal and radials), p. 15; fig. 265 (arm and pinnules), p. 207; figs. 410, 411 (pinnule tip), p. 255; figs. 626–628 (comb), p. 319; fig. 693 (disk), p. 341]

Comatula micraster A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 143 (description; Andaman Is., 60 fathoms); Memoirs Australian Mus., vol. 4, 1911, p. 742 (10-armed species related to *C. etheridgei*); p. 745 (never more than 10 arms); Crinoids of the Indian Ocean, 1912, p. 81 (synonymy; detailed description; localities); fig. 2, p. 82; p. 315 (additional localities); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 271 (listed); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 1, fig. 12 (disk).

Comatula (*Comatula*) *micraster* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 27 (in key; range; references; station 33).

Diagnostic features.—The absence of cirri and the small size, the arms not exceeding 65 mm. in length, readily distinguish this species from all the others in the genus.

Description.—The centrodorsal is rounded pentagonal, with its dorsal surface sunken to the level of the dorsal surface of the radials, or only very slightly above it.

Cirri absent.

The radials are short, trapezoidal, four or five times as broad as long. The elements of the IBr series are united by syzygy (pseudosyzygy) forming a unit which is about twice as broad as long. The IBr_1 are almost entirely, or quite, united laterally. The IBr_2 (axillaries) are free laterally.

The 10 arms are from 50 to 65 mm. long, and with the pinnules resemble those of *C. pectinata.*

The color in alcohol is white or light purple.

Notes.—The difference in the length of the anterior and posterior arms is often very great. In some specimens[6] only 4 of the 10 arms are provided with ambulacral grooves.

The specimen from *Investigator* station 387 has the arms about 45 mm. long. There are 2 cirri still remaining on the centrodorsal, which is much reduced.

The specimen from the Danish expedition to the Kei Islands station 83 is very small. One of the two from station 82 has the arms up to 35 mm. long; the centrodorsal is not quite sunken to the level of the radial pentagon, and shows a few obsolete cirrus sockets. The other specimen from station 82 is smaller, and the basal segments of 5 more or less developed cirri are attached to the centrodorsal.

The specimen from *Siboga* station 33 is typical.

Localities.—*Investigator* station 252; west of South Andaman Island (lat. 11° 50′ 30″ N., long. 92° 53′ 00″ E.); 110 meters; stones; April 10, 1899 [A. H. Clark, 1909, 1912] (45 U.S.N.M., 34935, 34939, 36194, 36245; I. M.). Pl. 41, figs. 112, 113, 115–124.

Investigator station 239; west of South Andaman Island (lat. 11° 49′ 30″ N., long. 92° 55′ 00″ E.); 100 meters; sand and stones; April 14, 1898 [A. H. Clark, 1912] (6, U.S.N.M., 34949; I. M.).

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[6] See vol. 1, pt. 2, fig. 693, p. 341.

Investigator station 387; off Cape Negrais, Burma, southwest of the mouths of the Irrawaddy River (lat. 15° 25′ 00″ N., long. 93° 45′ 00″ E.); 73–89 meters; sand and coral; November 16, 1909 [A. H. Clark, 1912] (1, U.S.N.M., 34639).

Investigator; two miles off Great West Torres Island, Mergui archipelago [A. H. Clark, 1912] (3, U.S.N.M., 34938; I. M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 83; off western Java (lat. 6° 42′ S., long. 105° 17′ E.); 45 meters; sandy mud; July 30, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Sunda Strait, between Java and Sumatra (lat. 6° 38′ S., long. 105° 21′ E.); 35 meters; sandy mud; July 30, 1922 (2).

Siboga station 33; Bay of Pidjot, Lombok; down to 22 meters; mud, coral, and coral sand; March 24–26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From the Gulf of Martaban and the Andaman Islands southward and southeastward to Lombok in the Lesser Sunda Islands.

Bathymetrical range.—From 22 to 109 meters; the average of 4 records is 79 meters.

Genus COMACTINIA A. H. Clark

Comatula (part) J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., April, 1840, p. 93, and following authors.

Alecto (part) J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 183, and following authors.

Comatula (*Alecto*) J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847 (1849), p. 250.

Antedon (part) Verrill, Proc. Boston Soc. Nat. Hist., 1866, p. 339, and following authors.

Actinometra (part) P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 155, and following authors.

Actinomedra von Graff, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, p. 132.

Comaster (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Phanogenia (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124.

Comactinia A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 498 (type *Alecto echinoptera* J. Müller, 1841); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Comactiniinae); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represents in the West Indies the East Indian *Comatula*); p. 652 (no infrabasals in the young); Mem. Australian Mus., vol. 4, 1911, p. 739 (represents the East Indian *Comatula* in the Caribbean Sea); p. 741 (closely related to *Comatula*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 389 (discussion of affinities and relationships; closely allied to *Comatula* and *Cominia* which it represents in the West Indies); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Comatula*); Internat. Revue der gesamt. Hydrobiol. u. Hydrogr., 1914, pp. 4 et seq. (represents in the Atlantic *Comatula* of of the Indo-Pacific; range and its significance); Beiträge zur Kenntnis der Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (Caribbean; corresponds to the East Indian *Cominia* and *Comatula;* connects the Caribbean Sea directly with the southwestern Indian Ocean); Journ. Washington Acad. Sci., vol. 5, No. 1, 1915, p. 8 (mostly closely related to the Australian *Comatulella;* does not occur on the eastern shores of the Atlantic); Die Crinoiden der Antarktis, 1915, p. 181 (range; represented in the Indo-Pacific by *Comatula*); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetry); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 24 (in key; range); Journ. Washington Acad. Sci., vol. 9, 1919, No. 5, p. 136 (disk compared with that of *Holopus*); Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies); p. 15 (in key); p. 21 (plant-like interrelationships of the included forms).

Comactinia (*Actinometra*) Goldring, Review of the Crinoidea Flexibilia, 1921, p. 3.

Diagnosis.—A genus of Comactiniinae including species in which there are only exceptionally more than XX cirri composed of not more than 25 segments of which none beyond the first, or first and second, are broader than long. The 10 arms may be short and stout, greatly elongated and becoming extremely attenuated distally, or very stout basally with the distal portion much prolonged and attenuated. The elements of the IBr series and first 2 brachials are short and broad, and are in lateral contact with their neighbors on either side. The ossicles in these 2 pairs are united by synarthry, the line of union appearing externally as 2 very narrow triangles converging to a common apex in the middorsal line. The segments of the genital pinnules are short and broad, usually much broader than long in the basal half of the pinnules, and more or less produced or carinate distally. There are no carinate processes on the basal segments of the oral pinnules.

Geographical range.—From Cape Lookout, N. C., southward throughout the Caribbean Sea and as far as Rio de Janeiro, Brazil.

Bathymetrical range.—From the shore line down to 508 meters.

Thermal range.—From 8.22° C. to 26.17° C.

Remarks.—In common with all other Atlantic comasterid genera when compared with their Indo-Pacific representatives, the genus *Comactinia* represents a more generalized type than *Comatula*, the genus to which apparently it is most closely allied.

While plainly evident, the features characteristic of the subfamily Comactiniinae are less strongly marked in *Comactinia* than in the other genera of the subfamily. The presence of synarthries between the elements of the IBr series and first two brachials give certain forms of the species of *Comactinia* very much the same general appearance as certain species of *Comissia*, though their true relationship is at once made clear by a glance at the highly characteristic cirri.

In the bewildering diversity of arm structure, apparently in response to local and restricted environmental conditions, the single species of this genus exceeds all other crinoids. The forms in which this diversity is manifested are the same as those seen in the more variable species of *Comatula*, especially in *C. pectinata*, but in *Comactinia* they are carried to greater extremes, probably in correlation with its much greater thermal and bathymetric range.

COMACTINIA ECHINOPTERA (J. Müller)

Plate 42, Figures 125–128; Plate 43, Figures 129, 130; Plate 44, Figures 131–135

[See also vol. 1, pt. 1, fig. 76 (lateral view), p. 129; figs. 241, 242 (ventral view of centrodorsal), p. 249; fig. 328 (cirrus), p. 281; figs. 408, 411, 412 (pentacrinoids), p. 317; fig. 421 (basal ray), p 321; figs. 457, 458 (dorsal view of radial pentagon), p. 355; pl. 4, fig. 548 (orals); pt. 2, figs. 19, 20, 23, 24 (centrodorsal and radials), p. 15; figs. 412, 413 (pinnule tip), p. 255; figs. 632–634 (comb), p. 323; figs. 691, 692 (disk), p. 341; figs. 702–709 (disk of young), p. 341; fig. 941 (pentacrinoid), p. 549; pl. 1, figs. 963, 964 (centrodorsal and radials); pl. 8, fig. 1019 (analysis of arm division); pl. 17, fig. 1072 (comb)]

Comatula echinoptera J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., April, 1840, p. 93 (intersyzygial interval); Archiv f. Naturgesch., 1840, vol. 1, p. 311 (intersyzygial interval).—Bronn, Die Klassen und Ordnungen der Strahlenthiere, II, Actinozoa, 1860, pl. 26, fig. 12 (calcareous particles from the disk).—Dujardin and Hupé, Hist. nat. des zoophytes, Échinodèrmes, 1862, p. 201 (synonymy; description).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position); p. 28 (marked comb on the oral pinnules).—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 106 (Carpenter writes him that this is identical with the 10-armed variety of *Actinometra pulchella*).

Alecto echinoptera J. MÜLLER, Archiv f. Naturgesch., 1841, vol. 1, p. 143 (description; locality unknown); Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 183 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841 (1843), p. 220 (description; carination of lower pinnules).—CARUS, Icones Zootomicae, vol. 5, 1857, fig. 12 (spicules).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 450 (probably, as said by Carpenter, from the West Indies); vol. 36, 1909, p. 498 (type of *Comactinia*); vol. 43, 1912, p. 383 (=*Comactinia echinoptera*).

Alecto echinophora J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1841 (1843), p. 224 (papillae of the disk).

Comatula (*Alecto*) *echinoptera* J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847 (1849), p. 250 (redescribed).

Comatula, sp. A. AGASSIZ, Contrib. Nat. Hist. U. S., vol. 5, 1864, p. 79, line 11 (Charleston, S. C.; pentacrinoids growing on the cirri).—E. C. and A. AGASSIZ, Seaside Studies in Nat. Hist., 1865 [2d edition 1871], p. 121 (Charleston; quite abundant along the shores of South Carolina); p. 122 (description of adults and pentacrinoids); figs. 153 (adult), 154 (pentacrinoids on a portion of a cirrus), p. 122.

Alecto meridionalis (L. Agassiz, MS.) E. C. and A. AGASSIZ, Seaside Studies in Nat. Hist., 1865 [2d edition, 1871], p. 121 (Charleston; quite abundant along the shores of South Carolina); p. 122 (description of adults and pentacrinoids); figs. 153 (adult), 154 (pentacrinoids on a portion of a cirrus), p. 122.—HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 423 (history).

Antedon meridionalis VERRILL, Proc. Boston Soc. Nat. Hist., 1866, p. 339 (possibly identical with *Alectro dentata* Say).—POURTALÈS, Bull. Mus. Comp. Zoöl., vol. 1, No. 11, 1869, p. 355 (west of Tortugas, 35 fathoms; off French reef, 45 fathoms; South Carolina; purple or yellow, or both mixed); vol. 5, No. 9, 1878, p. 214 (*Blake* stations 32 and 45; Charleston; Cape Frio, Brazil).—P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 20 (characters, as described by Pourtalès).—RATHBUN, Trans. Conn. Acad. Sci., vol. 5, 1879, p. 157 (range).—P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 156 (should read *Actinometra meridionalis*); p. 161 (sense organs); p. 162 (dimorphism of arms); p. 164 (description of pentacrinoids; characters of the young).—BELL, Proc. Zool. Soc. London, 1882, p. 533 (listed).—P. H. CARPENTER, Proc. Zool Soc. London, 1882 (1883), p. 746 (belongs to *Actinometra*).

Comatula holmesi POURTALÈS, Bull. Mus. Comp. Zoöl., vol. 1, No. 11, 1869, p. 355 (*nomen nudum*).

Comatula meridionalis P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 20 (has an excentric mouth and no comb on the oral pinnules); p. 27 (systematic position); Proc. Roy. Soc., vol. 28, 1879, p. 394.

Actinometra meridionalis P. H. CARPENTER, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 155 (p. 5 of separate) (specimens of varietal forms sent to Edinburgh and Copenhagen museums as *Antedon* [*Coccometra*] *hagenii*); p. 156 (at least four distinct types included under this name; discussion).—LUDWIG, Mém. Acad. Sci. Bruxelles, vol. 44, 1882, p. 6.—P. H. CARPENTER, Proc. Zool. Soc. London, 1882 (1883), pp. 743, et seq. (discussion of Bell's method of formulation and corrected formula).—VON GRAFF, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, p. 129 (off St. Lucia; off French reef; off Martinique; myzostomes); *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 14, 15, 16, 19 (off Barbados; 25° 33′ N., 84° 21′ W.; myzostomes); p. 38 (*Blake* station 203); p. 45 (*Blake* station 203; *Investigator*, off St. Lucia); p. 51 (west of Tortugas, U. S. Coast Survey, 100 fathoms; *Blake* stations 45, 249); p. 52 (Caribbean Sea); p. 54 (off French reef); p. 58 (west of Tortugas).—P. H. CARPENTER, Quart. Journ. Microsc. Sci., vol. 27, 1887, p. 386 (Bahia, Brazil; no trace of sacculi).—A. AGASSIZ, Bull. Mus. Comp. Zoöl., vol. 15 [reprinted as "Three Cruises of the *Blake*," vol. 2], 1888, p. 117, fig. 406 (pentacrinoids); p. 127 (myzostomes).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p, 301 (Bahia, 7–20 fathoms; South Carolina; west of Tortugas and off French reef in Florida Strait, 35–45 fathoms; Caribbean Sea, abundant between 50 and 262 fathoms; off

Cape Frio, Brazil, 35–45 fathoms); pl. 4, figs. 4, *a–c;* pl. 56, figs. 1, 2.—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, pp. 185, 186 (myzostomes).—Walther, Einleitung in die Geologie als historisches Wiss., 1894, p. 298.—Springer, Mem. Mus. Comp. Zoöl., vol. 25, 1901, No. 1, p. 34 (early stages in relation to *Uintacrinus*); p. 51 (comparison with *Uintacrinus*); p. 56 (pentacrinoids).—H. L. Clark, Bull. U. S. Fish. Comm., vol. 20 (for 1900), 1902, pt. 2, p. 235 (in key; *Fish Hawk* stations 6063, 6066).—McClendon, Bull. American Mus. Nat. Hist., vol. 22, 1906, p. 120 (myzostomes).—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584 (listed).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 281, 413 (=*echinoptera*); p. 419 (Müller's *echinoptera*, in Hartlaub's opinion, identical with this predominant form in the *Blake* collection); p. 421 (myzostomes); p. 422 (discussion).—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 76 (B. M., MS=*Comactinia echinoptera*+*C. meridionalis*).

Actinometra echinoptera P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 156 [p. 6 of separate] (specific validity).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed); p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882 (1883), pp. 744 et seq. (discussion of Bell's method of formulation, and corrected formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 300, 302 (possible identity with *meridionalis*).—Bell, Proc. Zool. Soc. London, 1894, p. 402 (habitat unknown; comparison with *Act.* [*Comissia*] *peregrina*.—Hamann, Bronns Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584 (listed).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 280 (listed); p. 281 (this species and *Antedon* [*Crinometra*] *brevipinna* comprise the bulk of the *Blake* collection; no species so variable in its characters as this); p. 413 (listed); pp. 415–471 (synonymy; detailed account); p. 416 (?loc. [type]); p. 418 (locality unknown); p. 425, fig. 12.

Actinomedra meridionalis von Graff, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, p. 132 (myzostomes).

Actinometra meridionalis var. *quadrata* (P. H. Carpenter, MS.) von Graff, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, p. 127 (*nomen nudum;* myzostomes).—von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 20, 39 (*Blake* stations 203 and 278; myzostomes).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 421 (same as preceding).

Actinometra meridionalis var. *carinata* (part) (P. H. Carpenter, MS.) von Graff, Bull. Mus. Comp. Zoöl., vol. 11, No. 7, 1883, pp. 130, 131, (off Cape Frio, Brazil).—von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 15, 16, 19 (same).—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, pp. 186, 210 (same).

Actinometra, sp. von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, p. 41 (closely allied to, if not identical with, *Act. meridionalis;* myzostomes; near Barbados).

Actinometra blakei (P. H. Carpenter, MS.) von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, p. 19 (myzostomes); p. 39 (*Blake* station 172); p. 46 (*Blake* stations 39, 203).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 280, 413 (listed); p. 420 (history); p. 421 (*Blake* stations 39, 172; myzostomes); pp. 471–473 (but not the specimen described from station 171 [figured on pl. 13, fig. 9] which is *Nemaster iowensis*).

Actinometra brasiliensis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 302 (Bahia, 7–20 fathoms; off Cape Frio, 35–45 fathoms); pl. 4, fig. 4.

Actinometra rubiginosa (not *Antedon rubiginosa* Pourtalès, 1869) H. L. Clark, Bull. U. S. Fish Comm., vol. 20 (for 1900), 1902, pt. 2, p. 235 (in key; *Fish Hawk* stations 6088, 6090).

Comaster echinoptera A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Comaster meridionalis A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia echinoptera A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Phanogenia meridionalis A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comactinia echinoptera A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 149 (occasionally possesses very long and greatly attenuated arms like *Comatula pectinata*); p. 150 (compared with *Cominia* [*Comatulides*] *decameros*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 383 (=*Alecto echinoptera* J. Müller, 1841); p. 389 (discussion, and comparison with *Neocomatella alata* [i. e., *pulchella*]); p. 390 (belongs to the Comactiniinae); Crinoids of the

Indian Ocean, 1912, p. 30 (=*Comatula* [*Alecto*] *echinoptera* J. Müller, 1849); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 11 (22° S., 40° W., 35–40 fathoms; Barbados; characters).—Hartmeyer, Mitt. Zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 234 (?loc.; type of Müller is Cat. No. 1047).—H. L. Clark, Univ. Iowa, Bull. Lab. Nat. Hist., vol. 7, No. 5, 1918, p. 8 (Bahama Exped. stations 2, 4, 5, 7, 9, 10, 11, 13).—A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, pp. 9–11 (occurrence at Barbados); p. 21 (plantlike interrelationships of the varieties); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, pl. 3, fig. 33 (proportions of the cirri).

Comactinia meridionalis A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 150 (compared with *Cominia decameros*); Proc. U. S. Nat. Mus., vol. 38, 1910, p. 331, footnote (pentacrinoids possess 5 interradials); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 18 (pentacrinoids resemble those of *Comanthus wahlbergii*); Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 449 (short arms due to comparatively cold habitat); Mem. Australian Mus., vol. 4, 1911, p. 788 (young specimens with pentacrinoids on cirri recorded); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 389 (French reef); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 11 (published references to specimens in the British Museum; Bahia, 7–20 fathoms; 18° 50′ S., 38° 47′ W., 30–34 fathoms; Gulf Stream, 100 fathoms; characters of the specimens).—Springer, Crinoidea Flexibilia, 1920, pp. 79, 80, 83 (Yucatan; description of pentacrinoids); pl. B, figs. 1–10; pl. C, figs. 1*a*–7 (pentacrinoids).—Mortensen, Studies in the Development of Crinoids, 1920, p. 72 (pentacrinoid compared with that of other species).—A. H. Clark, Univ. Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 8 (obtained by the Barbados-Antigua expedition); pp. 9–11 (occurrence at Barbados); p. 25 (stations 9, 11, 14, 51, 67, 78, 85, 96; Barbados); pp. 27, 28 (listed).

Actinometra echinoptera var. *echinoptera* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 424 (West Indies [type]; Barbados, in Kiel Mus.; French reef; discussion).

Actinometra echinoptera var. *meridionalis* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Bibb*, March 21 and April 3, 1869; French reef; off Cape Frio; off Charlotte Harbor; *Blake* stations 156, 177, ?155); p. 417 (*Blake* stations 203, 231, 247, 249, 272, 278, 297; Kiel Mus., Barbados, Capt. von Werner, 1872; *Blake* stations 30, 1880; ?loc., *Bache;* Kingsmill Is., 13 fathoms; Hong Kong); p. 418 (French reef; Charlotte Harbor; Montserrat; Dominica; Martinique; St. Vincent; Grenada; Barbados; 21° 26′ 30″ N., 86° 28′ 40″ W.; Cape Frio; Kingsmill Is.; Hong Kong; 13–278 fathoms); pp. 426–430 (detailed description; localities); p. 429 (characters of the pentacrinoids); pl. 16, figs. 2–5.

Actinometra echinoptera var. *meridionalis-carinata* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Bibb*, 1868; west of Tortugas; *Blake* stations 155, 156); p. 417 (*Blake* stations 45, 231, 286; 25° 33′ N., 84° 21′ W.; ?loc.); p. 418 (?St. Vincent; west of Tortugas; Montserrat; Barbados; 25° 33′ N., 84° 21′ W.; 7–101 fathoms); p. 435 (description); pl. 16, fig. 9.

Actinometra echinoptera var. *meridionalis-rubiginosa* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (Florida; *Blake* station 127); p. 418 (Florida; Sta. Cruz); p. 438 (detailed account); pl. 17, fig. 6 (Montserrat).

Actinometra echinoptera var. *meridionalis-valida* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (St. Lucia, 278 fathoms; *Blake* station 157); p. 417 (*Blake* station 246; ?loc.); p. 418 (Montserrat, Grenada, Barbados, St. Lucia; 120–163 fathoms); pl. 16, figs. 10–13; pl. 17, fig. 3.

Actinometra echinoptera var. *pulchella* (part) Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 440 (*Blake* stations 277 [at least 1], 298); p. 441 (*Blake* station 269 [1]); p. 442 (*Blake* station 156; 23° 32′ N., 88° 05′ W., 95 fathoms); p. 443 (25° 33′ N., 84° 21′ W., 101 fathoms).

Actinometra echinoptera var. *valida* Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 416 (*Blake* stations 219, 157, ?171); p. 417 (*Blake* stations 241, 277; *Hassler*, Barbados, 100 fathoms; ?loc.); p. 418 (Montserrat, Carriacou, ?Guadeloupe, St. Lucia, Barbados; 76–183 fathoms); pp. 430–431 (detailed description; Barbados, 106 fathoms; Dominica or Guadeloupe; ?23° 52′ N., 88° W., or 25° N., 84′ W.; Montserrat, 120 fathoms); p. 431, figs. 13, *a*, *b*; pl. 16, figs. 7, 8; pl. 17, fig. 10.

Actinometra echinoptera var. *valida-meridionalis* HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 417 (*Blake* station 272).

Actinometra echinoptera var. *rubiginosa* (part) HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 436; pl. 17, fig. 13 (*Blake* station 157).

Actinometra echinoptera var. *pulchella* (part) HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 442 (last record on page; 23° 32′ N., 88° 05′ W.).

Comactinia (*Actinometra*) *meridionalis* GOLDRING, Review of the Crinoidea Flexibilia, 1921, p. 3.

Diagnostic features.—The cirri, which are relatively short, rather stout, strongly curved, and composed of 8–12 segments, of which the distal, which are shorter than the proximal, are somewhat longer than broad, or at least no broader than long, and are entirely without dorsal spines or other processes and only slightly compressed laterally, distinguish this species at once from all the other Atlantic species of Comasteridae. The mouth is marginal and the anal cone usually occupies the center of the disk. The arms in adults vary from 40 to 150 mm. in length. They may be short and robust, exceedingly slender and elongated, or very robust proximally, increasing in width from the first to about the fourteenth brachial and thence gradually tapering and becoming greatly attenuated distally. In large and well-developed individuals the exceedingly strong dorsal processes on the segments of the lower and middle pinnules are very characteristic, making detached arms very easy to determine.

As a general rule the size increases proportionately with the depth, the smallest examples being those taken along the shores and the largest those from about 200 meters or over.

A specimen from Charleston has the arms about 45 mm. long and the cirri XXVI, 12, about 10 mm. long, arranged in one and a partial second row on a discoidal centrodorsal, of which the bare dorsal pole is 3 mm. in diameter.

In some others from off Habana in deep water the arms are 150 mm. long, stout basally but becoming very slender distally, instead of being robust throughout as in that from Charleston, and the cirri are XV–XX, 8–12, from 10 to 12 mm. long, the discoidal centrodorsal having a dorsal pole 4 mm. in diameter.

Description.—The centrodorsal is large, discoidal, with the bare polar area large, 4 or 5 mm. in diameter, flat or with a broad shallow central pit.

The cirri are XV–XX, 9–12 (usually 11), short and rather stout, from 10 to 12 mm. in length. The first segment is short, the second is usually about as long as broad, and the third and fourth are from half again to twice as long as broad. The following segments decrease gradually in length, the seventh and following being about as long as broad, or very slightly longer than broad. The antepenultimate segment is slightly longer, and the penultimate slightly shorter, than the segment preceding the former. The third and fourth segments are slightly constricted centrally. The cirri are smooth dorsally, the segments being without dorsal processes or overlapping ends. The opposing spine is small, erect, median in position. The terminal claw is about as long as the antepenultimate segment (considerably longer than the penultimate), and is stout and strongly curved basally, but becoming slender and nearly straight distally. The cirri are slightly compressed in the distal half.

The ends of the basal rays are visible in the interradial angles of the calyx, though they are not prominent.

The radials are concealed by the centrodorsal. The IBr_1 are very short and bandlike, and are closely united laterally. The IBr_2 (axillaries) are triangular, about twice as broad as long. The IBr series and the first 2 brachials are in lateral contact, though the latter are not laterally flattened.

The 10 arms are 150 mm. in length. The first brachials are short and slightly wedge-shaped. The second brachials are rather larger and irregularly quadrate. The first syzygial pair (composed of brachials 3 + 4) is somewhat longer inwardly than outwardly and about twice as broad as the interior length. The next 3 brachials are approximately oblong, or somewhat wedge-shaped, nearly three times as broad as long, those following becoming triangular, about as long as broad after the middle of the arm, and at the extreme tip very obliquely wedge-shaped and about as long as broad or somewhat longer. After the eighth the distal ends of the brachials are somewhat enlarged and overlap distally, though never to any great extent. There is a gradual increase in the width of the arms from the base to about the fifteenth–twentieth brachials, after which the arms taper away very gradually to a slender and delicate tip.

Syzygies occur between brachials 3 + 4, again from between brachials 9 + 10 to between brachials 12 + 13 (usually between brachials 11 + 12), and from between brachials 14 + 15 to between brachials 18 + 19, and distally at intervals of usually 5 muscular articulations.

The mouth is interradial, and the anal tube is central. The anal area usually bears a few scattered small calcareous concretions; sometimes it is more or less covered with rather large concretions.

P_1 is 15 mm. long, moderately stout basally, but becoming very slender after the basal third. It is composed of about 40 segments, which at first are broad with the corners cut away, but become about as long as broad after the tenth. The terminal comb is short, with only 7 teeth which are rounded-oblong and low, not so high as the width of the segments which bear them, and have their ends truncated. P_2 is 12 mm. long, resembling P_1, but not quite so stout basally. P_3 is about 11 mm. long, and P_4 is about 10 mm. long; these pinnules resemble P_2 and have similar combs. P_5 and the following pinnules are 10 mm. long, about as stout basally as those preceding but tapering much more gradually and not so slender distally, and without terminal combs. After the proximal third of the arm the pinnules gradually become more slender, though the distal pinnules are little, if any, longer than the genital pinnules. In the proximal third of the arm the pinnule segments develop strongly produced dorsal ends, this production being in the form of a rounded triangle with the apex central in regard to the joint surface in the basal portion, but gradually becoming distal in the outer part. The distal profile of the pinnules, therefore, is very strongly serrate, while the proximal profile is practically straight. In the first 4 pinnules this affects only the stouter basal portion, but in the genital pinnules it is marked for almost the entire length, though most so in the basal portion. Distally the relative proportion of the pinnule affected becomes progressively less and less, and it is not noticeable at all in the slender distal pinnules, though it may persist as a slight carination of the second and third pinnule segments to somewhat beyond the middle of the arm.

The color in alcohol is white.

Notes.—The preceding description is based upon specimens at hand from *Albatross* stations 2159 (10), 2160 (5), 2163 (3), 2166 (4), 2169 (1), 2320 (3), 2323 (9), 2326 (6), 2327 (11), 2329 (1), 2331 (5), 2335 (2), 2337 (1), 2338 (1), 2342 (2), from *Fish Hawk* station 6063 (4), and from *Albatross* material dredged "off Havana" (9).

These specimens correspond to those which were distinguished by Hartlaub as var. *valida.* To this variety which, according to him, is distinguished from var. *echinoptera* and var. *meridionalis* especially by its size, its color, and its massive structure, he assigned only a small number from among the specimens examined by him.

He believed this variety to be the same as the new species *Actinometra blakei,* which Carpenter had intended to describe.

In its appearance it is wholly different from most of the specimens of var. *meridionalis,* so that it gives the general impression of being a quite different species. But a closer study shows a very marked agreement in most features, and furthermore the material studied by Hartlaub included several intermediate specimens which he distinguished as var. *valida-meridionalis.*

In var. *valida,* as described by Hartlaub, the centrodorsal is relatively large, 5 mm. in diameter, and always bears numerous cirri which are usually arranged in two marginal rows.

The cirri are about XXV–XXX, and in their form resemble those of var. *meridionalis.*

In the larger specimens the arms reach a length of about 200 mm.

The elements of the IBr series and the first 2 brachials are in lateral apposition, and the 2 second brachials on a single post-radial series are usually in close apposition internally, though in a given individual there may be some exceptions to this last. As a result of the excessive shortening on the inner side of the arms the second brachials have a very characteristic form. Articular tubercles are sometimes developed. The proximal brachials are broad and flat. The syzygial pairs are not longer—indeed individual ones are even shorter—than the single brachials. The shape of the brachials remains the same from the eighth until far out on the arm, in one specimen as far as the one-hundredth brachial; they are very uniformly triangular. The dorsal surface of the arms is smooth from about the thirtieth brachial onward. The first 5 or 6 brachials are exceptionally short.

The intersyzygial interval is usually greater than in var. *meridionalis,* often 5 or 6 muscular articulations, but sometimes more.

The relative length of the proximal pinnules is variable. Sometimes P_2 is almost as long as P_1 and the length of the succeeding pinnules decreases to that of the twelfth brachial. In other cases the pinnule of the sixth or eighth brachial is the shortest. The relationships of the pinnules may vary in a single individual, as for instance in one from *Blake* station 277. Sometimes the pinnule of the sixth brachial bears a poorly developed comb. There is no carination of the basal pinnule segments.

Hartlaub remarked that the distinctive features of this variety are best shown by 2 specimens from Dominica or Guadeloupe, 4 from *Blake* station 277, 2 from which the label has been lost but which are apparently from lat. 23° 52′ N., long. 88° W., or from lat. 25° N., long. 84° W., and 1 from *Blake* station 157.

The color of typical specimens is white, or whitish with a tinge of brownish violet.

Hartlaub interpreted var. *valida* as a more robust representative of var. *meridionalis*.

Transitional forms.—Under the name of *Actinometra echinoptera* var. *meridionalis-valida* Hartlaub described a small number of specimens which he took for young individuals of var. *valida*. They are all characterized by a white or very light color, and most of them also by a relatively large centrodorsal and numerous cirri.

Among them are 4 specimens from *Blake* station 272. The color of the arms is light brownish, and they also resemble var. *meridionalis* in their slender arms. The large white centrodorsal which bears numerous cirri, the close contact of the IBr series, and the close approximation of the second brachials which are appressed against each other, are all features which indicate their affinity with var. *valida*. In 3 of them the syzygial pairs have the brevity characteristic of those of var. *valida*, while in the fourth they are formed more as in var. *meridionalis*. The pinnule of the sixth brachial has usually a short though prominent comb.

Quite similar are 4 specimens from *Blake* station 157. Their color is the characteristic white of var. *valida*, but in other respects they agree with var. *meridionalis*. Except for the youngest, which agrees in size with the oldest example from Cape Frio, they show a few of the characteristic features of var. *valida*. The brachials remain triangular until far out on the arm, the IBr_1 are in lateral contact, and the second brachials of each arm pair are closely crowded against each other.

The oldest of these 4 intermediate specimens has the size of a large specimen of var. *meridionalis* (from Martinique or Charlotte Harbor). In contrast to the other 3 it has a relatively large centrodorsal. But it shows little, or none at all, of the close apposition of the second brachials. Its brachials have the uniformly triangular shape which is so characteristic of var. *valida*.

A specimen from Grenada, in which unfortunately all the arms have been broken off at the base, according to Hartlaub belongs here. The centrodorsal is sharply pentagonal and the color is pure white.

A specimen from which the label has been lost, although very pale, has the arm color characteristic of many specimens of var. *meridionalis*, including 2 dorsal longitudinal stripes. But in its whitish general coloration and in its relatively large number of cirri it exhibits features characteristic of var. *valida*. In their considerable length the syzygial pairs resemble most closely those of var. *meridionalis*.

The large number of cirri is especially well shown in a much broken specimen from *Blake* station 219.

The type specimen of echinoptera.—Müller described the type specimen of *Alecto echinoptera* in the following terms. The centrodorsal is flat, with the larger central portion free of cirri. The cirri are XX, 11, with the segments laterally compressed. The 10 arms are 108 mm. in length. At the base of the arms the brachials are feebly imbricated. The intersyzygial interval is from 3 to 6 muscular articulations. P_1 is somewhat larger than those succeeding. The 7 last segments of the pinnules at the base of the arms have long high keels on the dorsal side, which form a saw-like profile (that is, a comb). The hinder portion of the third segment of P_1 has a strong process. The disk is beset with individual scattered small hard cylindrical papillae (that is, calcareous concretions).

Specimens from water with a depth of 10 meters or thereabouts usually have more or less uniformly slender arms which are intermediate in length between those of very shallow (*meridionalis*) and of deep (*valida*) water. With increasing depth the arms gradually become stouter basally.

The type specimen, which I have examined, thanks to the courtesy of Drs. W. Weltner and Robert Hartmeyer of the Berlin Museum, is of this intermediate character (var. *meridionalis-valida* of Hartlaub) with the arms stouter than those of the most slender forms, elongate instead of short like those of littoral examples, but not by any means so robust as in those from deep water. It probably was captured by a fisherman working over a reef in a few meters of water, very likely at Barbados.

Hartlaub wrote that this specimen shows so much resemblance to var. *meridionalis* that it is a question whether or not it should be considered as a different variety.

In the first place, its light violet color is striking. In all the material examined by Hartlaub the only specimens of *meridionalis* similarly colored were one from Barbados in the Kiel Museum and one from French Reef.

Hartlaub believed that in this species the different varieties are distinguished by characteristic coloration. Thus the var. *meridionalis* is a uniform light brown or dirty white, and the var. *valida* is pure white.

Hartlaub noted that the size of the type specimen much exceeds that of the numerous specimens of var. *meridionalis* from French Reef and Cape Frio, though only slightly that of the single specimen from Montserrat.

In comparison with the size of the arms the centrodorsal is relatively small.

The cirri are XXIII, short, with the segments similar in form to those of var. *meridionalis;* the opposing spine is exceptionally feeble.

The IBr_2 (axillaries) are in close lateral contact.

The arms are somewhat narrowed at the base. The proximal portion of the arms has a very uneven dorsal surface. The brachials in the proximal third of the arms are very short, and they remain short until far out on the arm, while in var. *meridionalis* the short brachials in the proximal portion of the arms earlier pass over into the elongate form.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 14+15, and distally usually at intervals of 3 or 4 muscular articulations.

As a result of the maturity of the sexual products the soft parts of the pinnules are strongly developed, while the calcareous ossicles are less conspicuous than usual. The pinnules are not essentially different from those of var. *meridionalis*. The comb on the oral pinnules is very poorly developed, and does not occur beyond P_4. P_1 is markedly longer than P_2.

According to Hartlaub the special features of this specimen are the color, the relatively small size of the centrodorsal and the cirri, the crowding of the IBr_2 (axillaries), and the shortness of the middle brachials. Hartlaub treated it as distinct from var. *meridionalis* and var. *valida* chiefly because in its general appearance it does not agree with either.

Description of the brachypoda form.—The calyx, cirri and arm bases in their general proportions are as in the preceding form. But the cirri are fewer, with fewer segments, XIII–XVI, 8–10, and short, 7 or 8 mm. in length; the arms are much elongated and slender, with proportionately longer brachials, and without the broadening of the proximal portion, reaching 150 mm. in length; the intersyzygial interval is from 3 to 6 (usually 3 or 4) muscular articulations; and the segments of the oral and genital pinnules are rather strongly carinate. Although this carination is not so excessive as it is in the preceding form, it is very noticeable. It is most marked on the second segment, becomes gradually less and less marked distally, and disappears at about the middle of the pinnule. The carinate processes are surmounted by a tuft of fine spines.

The color in alcohol is flesh color; or yellow with, in the proximal fourth of the arm, a broad lateral line, in the distal three-fourths a zigzag mediodorsal line, of purplish gray; or yellow; or brownish.

This form bears a strong superficial similarity to the species of the genus *Antedon*, especially to *A. petasus*.

Specimens of this type were examined from *Albatross* stations 2167 (3), 2330 (13), 2333 (8), from *Grampus* station 5104 (1), and from *Bibb* station 143P.

Description of the meridionalis form.—The centrodorsal is discoidal, moderate in size, thin to moderately thick, with the flat polar area about 3 mm. in diameter and usually slightly pitted. The cirri are arranged in from 1 to 2 closely crowded irregular marginal rows.

The cirri are XX–XXVII, 11–12 (usually 12), from 7 mm. to 9 mm. long. The first 2 segments are about twice as broad as long, the third and fourth are from one-third again as long as broad to somewhat over half again as long as broad, usually nearer the latter, and the succeeding segments decrease very gradually in length, those after the sixth being approximately equal, usually about one-third again as long as broad, though sometimes but little longer than broad. The antepenultimate segment is somewhat longer than that preceding, and is oblong in lateral view. The penultimate segment is shorter than that preceding the antepenultimate, slightly broader than long or about as long as broad. There are no dorsal spines or other processes. The opposing spine is very small and delicate, median and erect. The terminal claw is about as long as the antepenultimate segment, and is moderately stout and rather strongly curved. The segments after the second are slightly or moderately constricted centrally so that the articulations are more or less prominent, this feature becoming gradually less marked distally.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal, or are just visible over the ends of the basal rays. The IBr_1 are very short, and are usually more or less concealed by the centrodorsal; they are united laterally for nearly their whole length. The IBr_2 (axillaries) are triangular, usually about twice as broad as long or slightly broader, free and rounded laterally.

The 10 arms, which are stout basally and taper rapidly, are 65 mm. in length. The first brachials are very short, very slightly longer exteriorly than interiorly, almost oblong, interiorly united for about two-thirds of their length, the distal thirds diverging at rather more than a right angle. The second brachials are slightly larger and more pronouncedly wedge-shaped than the first. The first syzygial pair (composed of brachials 3 + 4) is oblong, from two and one-half to nearly three times as broad as long. The next 2 brachials are similar to the third and fourth; those following become obliquely wedge-shaped and longer, and after the ninth or tenth triangular or very obliquely wedge-shaped, two-thirds or three-quarters as long as broad, later becoming triangular or obliquely wedge-shaped, about as long as broad, and in the terminal portion of the arm less obliquely wedge-shaped, and finally elongate, twice as long as broad, or even somewhat longer. The fifth and following brachials have more or less prominent distal ends, this feature soon becoming less marked and usually dying away at about the middle of the arm, after which point the brachials are practically smooth.

Syzygies occur between brachials 3 + 4, again usually between brachials 11 + 12 (sometimes also between brachials 6 + 7), and distally at intervals of 3 muscular articulations.

P_1 is about 10 mm. long, moderately stout basally but tapering evenly to a slender and delicate tip. It is composed of about 35 segments, most of which are about as long as broad. The terminal comb consists of 9 teeth which are spade-shaped or almost circular, small, in height equal to only about one-half the width of the segments which bear them, and well separated. P_2 is half as long as P_1, 5 mm. in length, and much more slender. It is composed of 15–20 segments, most of which are about as long as broad, and bears a comb distally. P_3 is slightly shorter than P_2, 4 mm. long, and is without a terminal comb. P_4 is as long as P_2, 5 mm. in length, but is somewhat stouter than those preceding it, and carried a gonad. The following pinnules are similar, toward the end of the proximal third of the arm gradually increasing in length and becoming more slender. The distal pinnules are from 8 to 9 mm. long. The pinnules are practically smooth, with no trace of dorsal carination. The distal ends of the segments are slightly everted and finely spinous.

The color in alcohol is dark brown; in life, purple or yellow or a mixture of both.

The preceding description is based chiefly upon a specimen from the Blackfish Banks, off Charleston, S. C., taken in 22 meters of water.

Notes.—In the larger of the two specimens labeled "Type," which are from Charleston, S. C. (M. C. Z., 33), the dorsal pole of the centrodorsal is broad and flat, 3 mm. in diameter. The cirrus sockets are arranged in one and a partial second marginal row. The cirri are XXVI, 12, about 10 mm. long. The arms are about 45 mm. long. The smaller specimen has the arms about 30 mm. in length.

Another specimen from Charleston (M. C. Z., 446) has the cirri XX, 10–12, 7 mm. long, and the arms about 45 mm. in length.

Of var. *meridionalis* Hartlaub studied 131 specimens, of which three-fourths came from French Reef (39), Cape Frio (35), and Martinique. He said that the specimens from French Reef served as the basis for the original description of the species. This is not quite correct. The form was originally described, very inadequately, in 1865 from specimens from Charleston, S. C. The French Reef specimens served as the basis for Pourtalès' redescription in 1869.

As described by Hartlaub the centrodorsal is thin and flat, with a mostly smooth surface, more or less prominently pentagonal, reaching 3 mm. in diameter. The cirri are marginal, usually in a single row, rarely in 2 rows.

The cirri are usually about XV, rarely so many as XVIII (as in a specimen from Charleston), with the segments commonly 10 in number. The cirri are short, from 6 to 7 mm. in length, and moderately slender. The first 2 segments are short, those following being somewhat elongated and approximately of the same length, though the third and fourth are sometimes longer than the others. The segments are cylindrical, slightly constricted centrally, with the distal edge scarcely produced. There are no dorsal spines and the opposing spine is usually feebly developed. The terminal segment (in specimens from Cape Frio) is sometimes much compressed.

The radials are visible in young specimens (Cape Frio). In young individuals (as all the specimens from Cape Frio) the IBr_1 are short and laterally free, but in older examples they are in lateral contact, and the apposed sides are somewhat thickened. The IBr_2 (axillaries) are short, almost or quite triangular, with the distal sides slightly concave. The dorsal surface is either smooth and evenly rounded (French Reef and *Blake* station 249), or these ossicles have somewhat everted distal edges (Dominica).

There are 10 arms. The first brachials are short and discoidal, and are rarely wholly in contact interiorly; in the young (Cape Frio) they are entirely free. The second brachials are also short, somewhat longer exteriorly than interiorly, and have a slightly produced angle on the distal border, which occurs on all the brachials following. They are free interiorly, though sometimes they are very close together (as in a single specimen from Martinique). The first syzygial pair (composed of brachials $3+4$) is usually short and, like the following brachials, discoidal, rarely so long as broad (Cape Frio). The fifth brachial is sometimes (as in specimens from French Reef and Cape Frio) provided with a process directed proximally on its lower border. A similar process sometimes also occurs (Martinique) on the short wedge-shaped sixth brachial. From the seventh onward the brachials become triangular and are at first as a rule very short (somewhat longer in the specimens from Cape Frio). The distal edge of the brachials is always concave; the proximal border may also be concave (Cape Frio), but it is more commonly toothed and rarely (Martinique) straight.

The distal edge of all of these triangular brachials is more or less strongly everted and dentate, sometimes also including the syzygial lines. The produced distal borders overlap the following brachials only very slightly if at all. At about the twenty-second the length of the triangular brachials increases. In the younger individuals, in which the proximal portion of the arm is much smoother than in the older, the triangular brachials earlier pass over into a bluntly wedge-shaped form with a correlated increase in length. In older examples (those from Martinique and certain individuals from French Reef) the brachials first become wedge-shaped, as a rule at about the thirtieth, while in certain others (*Blake* stations 155 and 249) they remain sharply triangular until the sixtieth. The outermost brachials are elongated and somewhat wedge-shaped. In the distal half of the arms the dorsal surface becomes markedly smoother. Except for those at the base of the arms, the syzygial pairs are always longer and less wedge-shaped than the adjacent brachials. The greatest width of the arms is from 1.5 to 2 mm., and is usually at the base, more rarely at about the sixteenth brachial. The width, especially on the short posterior arms, decreases very rapidly, so that even before the middle the arm appears very slender. The posterior arms are markedly shorter than the anterior, and are composed of shorter brachials which appear more crowded and give these arms a rougher dorsal surface. They usually have at the base an ambulacral groove without tentacles, the groove being more rarely wholly absent. The total length of an arm in the larger specimens examined by Hartlaub is about 150 mm.

Syzygies occur between brachials 3+4 (more rarely between brachials 4+5; *Blake* station 249), again from between brachials 10+11 to between brachials 12+13 (more rarely between brachials 13+14), and distally at intervals of from 4 to 7, usually 4 or 5, muscular articulations.

The pinnules on the arm bases have the proximal portion of the outer profile strongly dentate as a result of the basal segments being short and broad, distally increasing in width, the broad distal border overlapping the narrow base of the segment succeeding. This is most conspicuous at the distal angles of the pinnule segments, and the third and fourth segments are distinguished by especially broadened and finely spinous processes which sometimes similate carinate processes. But the segments may also be triangular (*Blake* station 249), in which case they are in contact only at a single point. In younger individuals (Cape Frio and the violet specimen from Barbados in the Kiel Museum) the dentation of the profiles of the lower pinnules is more or less wholly lacking and the width of the proximal segments is relatively much less. The distal pinnules are uniformly slender, and their segments, with the exception of the 2 first, are elongated.

P_1 is from 10 to 12 mm. in length, and is composed of about 30 short segments; after the first 5 or 6 segments, which are broadened, it becomes abruptly filiform. A terminal comb with weak teeth is clearly distinguishable. P_2 is similar to P_1, but is only about half as long. P_3 is still shorter and is somewhat variable in form, in that only the pointed tip may be slender (French Reef). P_2 and P_3 are more slender than the pinnules following. From P_4 onward the length of the pinnules gradually increases again. P_4 and the succeeding pinnules are very similar. Toward the twentieth brachial the processes on the pinnule segments disappear as a result of the segments passing over from a triangular to an elongate cylindrical form. On the inner side of the arm P_b is the shortest pinnule, while P_a is markedly shorter than P_1. Only the first 2 pinnules on each side of the arm bear combs.

In the larger specimens the disk has a diameter of 8 mm. It usually bears a few scattered concretions, especially in the anal area. The ambulacral grooves are sometimes thickly bordered with calcareous plates. The mouth is interradial.

The color in alcohol is typically light brownish yellow, often passing into whitish. Many specimens (French Reef) are darker, with a tinge of violet (French Reef) or pure brown (Charlotte Harbor), or entirely light violet (Barbados), or pure white (Dominica and Grenada). A number of specimens from French Reef and one specimen from Montserrat have 2 usually broad dark longitudinal lines on the arms which distally become united into a single line. Many specimens (French Reef) have a broad dark band running dorsally along the arms which one may interpret as arising from the union of 2 longitudinal stripes.

Hartlaub says that the characteristic features of this variety are the slender habitus, the fairly subequal shortness of all the cirrus segments, the laterally free division series and second brachials, the shortness of the brachials, the absence of a keel on the first and second segments of the proximal pinnules, the poorly developed combs on the oral pinnules, and a marked difference in the length of the anterior and posterior arms.

Hartlaub noted that many specimens by their unusually slender build, somewhat elongate brachials, and smooth arm bases approach in appearance the very slender *Leptonemaster venustus*—for instance, one from Barbados. Others show a similarity to the robust var. *valida*, which they approach by their pure white color, the shortness of the brachials, and sometimes in the apposition of the division series—as, for example, specimens from Grenada and Dominica.

The very young individuals of an arm length of about 7.5 mm. show the usual juvenile characters, as the exposed radials. Their cirri are very slender and are composed of uniform somewhat elongated segments. P_1 is developed, and in the specimens from Cape Frio is provided with a very prominent comb. The brachials from the second to the eighth or tenth have either no pinnules at all or only rudimentary stumps, while the eighth, or usually the tenth, and following brachials again possess pinnules of considerable length. On the inner side of the arms the pinnules begin on the ninth brachial.

The specimens studied by Hartlaub had an arm length of from 7.5 to 10 mm., and about X cirri were developed. Those from French Reef had no pinnules on the third-eighth brachials, while a somewhat larger one without locality [but undoubtedly from *Blake* station 32] showed stumplike beginnings of pinnules. On the third, sixth, and seventh brachials these are of the same length, while the pinnules of the fourth and fifth brachials are indicated by small swellings.

Description of the brasiliensis form.—The centrodorsal is small, discoidal, with the bare polar area flat. The marginal cirri are arranged in a single row.

The cirri are IX–XII, 8–10 (usually 9), rather slender, 5 mm. long. The first segment is very short, the second is about twice as broad as long, the third is about half again as broad as long, and the fourth and fifth are the longest, nearly twice as long as broad. The remaining segments are slightly longer than broad. There is no opposing spine. The terminal claw is about as long as the penultimate segment, or slightly longer, moderately stout, strongly curved basally, but becoming nearly straight distally.

The arms resemble those of the *meridionalis* form, and are about 40 mm. long. The distal intersyzygial interval is 3 muscular articulations.

The pinnules are very slightly carinate, and in general resemble those of the *meridionalis* form; but P_2 resembles P_3 and is without a terminal comb.

The color in alcohol is light purplish brown.

The preceding description was drawn up from 25 specimens from Cape Frio, Brazil, taken in 64–82 meters. The specimens from Cape Frio mentioned by Hartlaub as referable to var. *meridionalis* are others from the same lot.

Localities.—*Fish Hawk* station 7334; off Cape Lookout, N. C. (lat. 33° 57′ 30″ N., long. 76° 28′ 30″ W.); 121 meters (5, U.S.N.M., 34641).

Charleston, S. C.; Prof. Louis Agassiz [A. Agassiz, 1864; E. C. and A. Agassiz, 1865, 1871] (6, and about 8 pentacrinoids, M. C. Z., 32, 33, 34, 446).

Shores of South Carolina [E. C. and A. Agassiz, 1865, 1871].

Blackfish Banks, off Charleston, S. C.; 22 meters; R. E. Earll (1, U.S.N.M., 3803). Pl. 42, fig. 128.

Blake station 45; northwest of the Dry Tortugas, Fla. (lat. 25° 33′ 00″ N., long. 84° 21′ 00″ W.); 185 meters; temperature 16.5° C.; 1877–78 [Pourtalès, 1878].

Bibb station 165P (No. 3T on charts and in record book; No. 3 in Bulletin); off French Reef (lat. 25° 01′ 20″ N., long. 80° 19′ 30″ W.); 80 meters; April 3, 1869 (4, M. C. Z., 115).

Bibb station 143P (No. 2 in Bulletin); off French Reef; 82 meters; March 21, 1869 [Pourtalès, 1869] (49, U.S.N.M., 34624; M. C. Z., 433; C. M.). Pl. 44, fig. 132.

Bibb; off French Reef; 28–172 meters; April 3, 1869 [Hartlaub, 1912] (20, M. C. Z., 200, 294).

Off French Reef [Hartlaub, 1912] (3, M. C. Z., 417; Berl. M., 2962).

Gulf Stream; U. S. Coast Survey; 183 meters [von Graff, 1884; Hartlaub, 1912; A. H. Clark, 1913] (2, B. M.; C. M.).

Bibb station 84P, 87P, or 88P; west of the Dry Tortugas (lat. 24° 40′ 30″ to 24° 43′ 30″ N., long. 83° 15′ 00″ to 83° 30′ 30″ W.); 64 meters; January 16, 1869 [Pourtalès, 1869] (1, M. C. Z., 447).

Florida [Hartlaub, 1912] (3, M. C. Z., 81, 452).

No locality (but undoubtedly southern Florida) (2, M. C. Z., 413, 414).

Bache station 448; off Charlotte Harbor, Fla. (lat. 27° 07′ 30″ N., long. 85° 11′ 00″ W.); 92 meters; temperature 23.33° C.; April 19, 1872 [Hartlaub, 1912] (2, M. C. Z., 431).

Grampus station 5104; western coast of Florida (lat. 26° 13′ 00″ N., long. 83° 44′ 00″ W.); 93 meters; temperature 20.56° C.; white sand; March 18, 1889 (1, U.S.N.M. 34825).

Blake station XVII, 1880; south of Chinchorro bank, off the eastern coast of Yucatan (lat. 18° 22′ 20″ N., long. 87° 21′ 30″ W.); 75 meters; temperature 26.11° C. (1, M. C. Z., 213).

Blake station 39; 16 miles north of Jolbos Island, southwestern part of the Yucatan bank; 26 meters; 1877–78 [von Graff, 1884].

Blake station 32; northern part of the Yucatan bank (lat. 23° 32′ 00″ N., long. 88° 05′ 00″ W.); 174 meters; 1877–78 [Pourtalès, 1878].

Albatross station 2363; off Yucatan (lat. 22° 07′ 30″ N., long. 87° 06′ 00″ W.); 39 meters; January 30, 1885 [Springer, 1920] (44, and about 200 pentacrinoid larvae; U.S.N.M. Nos. 16909, 34591, 34607, 34611, 34612, 36223).

Blake station XXX, 1880; east of Cape Catoche, Yucatan (lat. 21° 26′ 30″ N., long. 86° 28′ 40″ W.); 93 meters; temperature 20.56° C.; May, 1880 [Hartlaub, 1912] (fragments, M. C. Z., 434).

Probably off Yucatan; 173 meters (2, M. C. Z., No. 502).

Albatross station 2160; off Habana, Cuba (lat. 23° 10′ 31″ N., long. 82° 20′ 37″ W.); 305 meters; April 30, 1884 (3 ,U.S.N.M. 34817, 34826).

Albatross station 2166; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 20′ 30″ W.); 358 meters; temperature 22.17° C.; May 1, 1884 (11, U.S.N.M. 16903, 21708, 34638, 34828, 35885).

Albatross station 2167; off Habana, Cuba (lat. 23° 10′ 40″ N., long. 82° 20′ 30″ W.); 368 meters; May 1, 1884 (12, U.S.N.M., 34832, 36145).

Albatross station 2163; off Habana, Cuba (lat. 23° 10′ 31″ N., long. 82° 20′ 29″ W.); 243 meters; April 30, 1884 (3, U.S.N.M., 34827).

Albatross station 2169; off Habana, Cuba (lat. 23° 10′ 28″ N., long. 82° 20′ 27″ W.); 143 meters; May 1, 1884 (1, U.S.N.M., 34637).

Albatross station 2162; off Habana, Cuba (lat. 23° 10′ 30″ N., long. 82° 20′ 25″ W.); 223 meters; April 30, 1884 (1, U.S.N.M., 7185).

Albatross station 2324; off Habana, Cuba (lat. 23° 10′ 25″ N., long. 82° 20′ 24″ W.); 60 meters; temperature 26.17 C.; January 17, 1885 (1, U.S.N.M., 16908).

Albatross station 2335; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 21″ W.); 373 meters; January 19, 1885 (2, U.S.N.M., 34545).

Albatross station 2337; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 21″ W.); 364 meters; January 19, 1885 (1, U.S.N.M., 34544).

Albatross station 2342; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 21″ W.); 368 meters; January 19, 1885 (2, U.S.N.M., 34547).

Albatross station 2168; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 20′ 20″ W.); 223 meters; May 1, 1884 (1, U. S. N. M., 34819).

Albatross station 2159; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 20′ 08″ W.); 180 meters; April 30, 1884 (8, U.S.N.M., 34642).

Albatross station 2332; off Habana, Cuba (lat. 23° 10′ 38″ N., long. 82° 20′ 06″ W.); 285 meters; January 19, 1885 (1, U.S.N.M., 34588).

Albatross station 2331; off Habana, Cuba (lat. 23° 10′ 31″ N., long. 82° 19′ 55″ W.); 209 meters; January 17, 1885 (4 and fragments U.S.N.M., 34549, 34550, 34551).

Albatross station 2330; off Habana, Cuba (lat. 23° 10′ 48″ N., long. 82° 19′ 15″ W.); 221 meters, January 17, 1885 (13, U.S.N.M., 34552, 34916).

Albatross station 2333; off Habana, Cuba (lat. 23° 10′ 36″ N., long. 82° 19′ 12″ W.); 309 meters; January 19, 1885 (7, U.S.N.M., 34917).

Albatross station 2323; off Habana, Cuba (lat. 23° 10′ 51″ N., long. 82° 19′ 03″ W.); 298 meters; January 17, 1885 (9, U.S.N.M., 34543, 34546).

Albatross station 2326; off Habana, Cuba (lat. 23° 11′ 45″ N., long. 82° 18′ 54″ W.); 355 meters; temperature 16.67° C.; January 17, 1885 (5, U.S.N.M., 34542).

Albatross station 2336; off Habana, Cuba (lat. 23° 10′ 48″ N., long. 82° 18′ 52″ W.); 287 meters; January 19, 1885 (5, U.S.N.M., 34590).

Albatross station 2320; off Habana, Cuba (lat. 23° 10′ 39″ N., long. 82° 18′ 48″ W.); 238 meters; January 17, 1885 (5, U.S.N.M., 34539, 34540, 34541).

Albatross station 2329; off Habana, Cuba (lat. 23° 11′ 03″ N., long. 82° 18′ 45″ W.); 216 meters; January 17, 1885 (1, U.S.N.M., 34548).

Albatross station 2334; off Habana, Cuba (lat. 23° 10′ 42″ N., long. 82° 18′ 24″ W.); 122 meters; January 19, 1885 (36, U.S.N.M., 34610).

Albatross station 2327; off Habana, Cuba (lat. 23° 11′ 45″ N., long. 82° 17′ 54″ W.); 333 meters; January 17, 1885 (12+, U.S.N.M., 34589, 34618).

University of Iowa's Bahamas expedition station 2; off Habana, Cuba; 201 meters [H. L. Clark, 1918] (Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 4; off Habana, Cuba; 201 meters [H. L. Clark, 1918] (Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 5; off Habana, Cuba; 256 meters [H. L. Clark, 1918] (Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 7; off Habana, Cuba; 256 meters [H. L. Clark, 1918] (Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 9; off Habana, Cuba; 366 meters [H. L. Clark, 1918] (M. C. Z., 745; Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 10; off Habana, Cuba; 366 meters [H. L. Clark, 1918] (M. C. Z., 731; Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 11; off Habana, Cuba; 366 meters [H. L. Clark, 1918] (M. C. Z., 751; Univ. Iowa Mus.[7]).

University of Iowa's Bahamas expedition station 13; off Habana, Cuba; 366 meters [H. L. Clark, 1918] (M. C. Z., 743; Univ. Iowa Mus.[7]).

Albatross stations 2156–2163; off Habana, Cuba; 53–508 meters; April 30, 1884 (1, U.S.N.M., 34537).

Albatross stations 2319–2350; off Habana, Cuba; 60–510 meters; January 17–20, 1885 (5, U.S.N.M., 34538, 34889). Pl. 42, fig. 127; pl. 43, fig. 129.

Off Habana, Cuba; *Albatross*, 1885 (4 and fragments, U.S.N.M., 14698, 24261, 36246, 36267, 36268).

Fish Hawk station 6066; Mayaguez Harbor, Porto Rico, Punta del Algarrobo bearing E. 4⅝ miles distant; 294–314 meters; January 20, 1899 [H. L. Clark, 1902] (fragments, U.S.N.M., 21465).

Fish Hawk station 6063; Mayaguez Harbor, Porto Rico, Punta del Algarrobo bearing E. 2¾ miles distant; 137–140 meters; January 20, 1899 [H. L. Clark, 1902] (4, U.S.N.M., 21464).

Fish Hawk station 6088; off Vieques Island, Sail Rock bearing NE. ¼ N., 10¾ miles distant; 42 meters; coral; February 8, 1899 [H. L. Clark, 1902].

Fish Hawk station 6090; off Culebra Island, Culebritas Lighthouse bearing NNE., 5¾ miles distant; 29 meters; February 8, 1899 [H. L. Clark, 1902] (fragments, U.S.N.M., 21466).

Blake station 127; off Santa Cruz (lat. 17° 46′ 10″ N., long. 64° 53′ 15″ W.); 70 meters; temperature 24.83° C.; January 4, 1878 [Hartlaub, 1912] (1, M. C. Z., 453).

Blake station 155; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [Hartlaub, 1912] (6, M. C. Z., 419, 454, 473, 495).

Blake station 156; off Montserrat (lat. 16° 41′ 54″ N., long. 62° 13′ 24″ W.); 161 meters; temperature 20.56° C.; January 16, 1879 [Hartlaub, 1912] (3, M. C. Z., 435).

Blake station 157; off Montserrat; 220 meters; January 1879 [Hartlaub, 1912] (5, M. C. Z., 455, 498).

Blake; off Montserrat; 161–220 meters; 1879 [Hartlaub, 1912] (3, M. C. Z., 412).

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[7] There were 31 specimens from the University of Iowa's Bahamas expedition which Dr. H. L. Clark most courteously permitted me to examine at Cambridge.

Blake station 171; off Guadeloupe (lat. 15° 58′ 20″ N., long. 61° 43′ 12″ W.); 335 meters; temperature 13.05° C.; January 22, 1879 [Hartlaub, 1912] (1, M. C. Z., 611).

Blake station 172; off Guadeloupe (lat. 15° 58′ 10″ N., long. 61° 42′ 55″ W.); 113 meters; temperature 23.61° C.; January 22, 1879 [von Graff, 1883, 1884].

Blake station 177; off Dominica (lat. 15° 32′ 18″ N., long. 61° 30′ 10″ W.); 216 meters; temperature 18.33° C.; January 24, 1879 [Hartlaub, 1912] (3, M. C. Z., 416, 436).

Blake station 203; off Martinique (lat. 14° 28′ 50″ N., long. 61° 05′ 40″ W.); 176 meters; temperature 16.11° C.; February 10, 1879 [von Graff, 1883, 1884; Hartlaub, 1912] (41, M. C. Z., 216, 218, 219, 221, 411, 420, 437).

Blake; off Martinique or Grenada (1, M. C. Z., 427).

Blake station 219; off St. Lucia (lat. 13° 49′ 50″ N., long. 61° 03′ 50″ W.); 276 meters; temperature 13.89° C.; February 15, 1879 [Hartlaub, 1912] (fragments, M. C. Z., 499).

Cable repair ship *Investigator;* near St. Lucia (lat. 13° 22′ N., long. 61° 07′ W.); 508 meters; Captain Cole [von Graff, 1883, 1884] (1, M. C. Z., 456).

Blake; Dominica or Guadeloupe; 1879 [Hartlaub, 1912] (2, M. C. Z., 409).

Hassler stations 217P–220P; off Sandy Bay, Barbados; 137–183 meters; December 29, 1871 [Hartlaub, 1912] (1, M. C. Z., 410).

Blake station 272; off Barbados (lat. 13° 04′ 12″ N., long. 59° 36′ 45″ W.); 139 meters; temperature 18.17° C.; March 5, 1879 [Hartlaub, 1912] (6, M. C. Z., 442, 458).

Blake station 277; off Barbados (lat. 13° 03′ 55″ N., long. 59° 38′ 25″ W.); 194 meters; temperature 14.44° C.; March 5, 1879 [Hartlaub, 1912] (6, M. C. Z., 225, 501).

Blake station 278; off Barbados (lat. 13° 04′ 50″ N., long. 59° 37′ 40″ W.); 126 meters; temperature 20.00° C.; March 6, 1879 [von Graff, 1883, 1884] (4, M. C. Z., 226, 441).

Blake station 286; off Barbados (lat. 13° 10′ 58″ N., long. 59° 38′ 25″ W.); 12 meters; March 8, 1879 [Hartlaub, 1912].

Blake station 297; off Barbados (lat. 13° 02′ 36″ N., long. 59° 37′ 45″ W.); 225 meters; temperature 13.61° C.; March 10, 1879 [Hartlaub, 1912].

Blake station 298; off Barbados (lat. 13° 03′ 28″ N., long. 59° 37′ 40″ W.); 220 meters; temperature 16.11° C.; March 10, 1879 [Hartlaub, 1912] (1, M. C. Z. No. 486).

University of Iowa's Barbados-Antigua expedition, 1918, station 9; Barbados (arms, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 11; Barbados (4, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 14; Barbados (1, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 51; Barbados (1, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 67; Barbados (5, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 78; Barbados (2, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 85; Barbados (1, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918, station 96; Barbados (4, Univ. Iowa Mus.).

University of Iowa's Barbados-Antigua expedition, 1918; Barbados [A. H. Clark, 1921] (1, Univ. Iowa Mus.).

Barbados; Capt. von Werner, 1872; Kiel Museum [Hartlaub, 1912].

Barbados [A. H. Clark, 1913] (1, B. M.).

Blake station 231; off St. Vincent (lat. 13° 12′ 10″ N., long. 61° 17′ 18″ W.); 174 meters; 16.39° C.; February 20, 1879 [Hartlaub, 1912] (2, M. C. Z., 438).

Blake station 269; off St. Vincent (lat. 13° 07′ 55″ N., long. 61° 05′ 36″ W.); 227 meters; temperature 14.17° C.; March 3, 1879 [Hartlaub, 1912].

Blake station 241; off Carriacou (lat. 12° 28′ 22″ N., long. 61° 32′ 18″ W.); 298 meters; temperature 11.67° C.; February 24, 1879 [Hartlaub, 1912] (1, M. C. Z., 500).

Blake station 246; off Grenada (lat. 12° 05′ 45″ N., long. 61° 45′ 40″ W.); 282 meters; temperature 13.33° C.; February 25, 1879 [Hartlaub, 1912] (1, M. C. Z., 457).

Blake station 247; off Grenada (lat. 12° 05′ 25″ N., long. 61° 47′ 15″ W.); 311 meters; temperature 11.95° C.; February 25, 1879 [Hartlaub, 1912] (1, M. C. Z., 439).

Blake station 249; off Grenada (lat. 11° 48′ 15″ N., long. 61° 48′ 45″ W.); 479 meters; temperature 8.33° C.; March 1, 1879 [von Graff, 1883, 1884; Hartlaub, 1912] (4, M. C. Z., 224, 415, 440).

Caribbean Sea; 92–479 meters [P. H. Carpenter, 1888].

Albatross station 2142; eastern part of the Gulf of Darien, Colombia (lat. 9° 30′ 15″ N., long. 76° 20′ 30″ W.); 77 meters; March 23, 1884 (2, U.S.N.M., 34824). Pl. 43, fig. 130; pl. 44, fig. 131.

Challenger; Bahia, Brazil (about lat. 13° S.); 13–37 meters; 1873 [P. H. Carpenter, 1888] (4, B. M.).

South of the Abrolhos Islands, Brazil (lat. 18° 50′ S., long. 38° 47′ W.); 55–62 meters; temperature 23.89° C. [A. H. Clark, 1913] (1, B. M.).

East of Cabo de São Thomé, province of Rio de Janeiro, Brazil (lat. 22° S., long. 40° W.); 64–73 meters [A. H. Clark, 1913] (3, B. M.).

Hassler station 237P; off Cape Frio, Brazil (lat about 23° S., just east of Rio de Janeiro); 82 meters; January 22, 1872 [Pourtalès, 1878] (44, M. C. Z., 443).

Hassler station 236P; off Cape Frio, Brazil; 64 meters; January 22, 1872 [Pourtalès, 1878] (72, U.S.N.M., 34623, 35630; M. C. Z., 31, 199).

?Rio de Janeiro, Brazil (about lat. 23° S.) (1, M. C. Z., 76).

Locality unknown, but probably West Indies; Captain Wendt [J. Müller, 1840, 1841, 1849; Carus, 1857; Dujardin and Hupé, 1862; P. H. Carpenter, 1882, 1884, 1888; A. H. Clark, 1912] (1, Berl. M., 1047). Pl. 42, figs. 125–126.

Blake; no locality label (1, M. C. Z., 222).

No data (7, M. C. Z., 444, 451).

Erroneous localities.—Kingsmill Islands; 13 fathoms; *Bache* [Hartlaub, 1912].

The *Bache* was never in the Gilbert (Kingsmill) Islands; but if we may assume that Kingsmill was a slip for Marquesas the following locality is indicated:

Bache station 35S; north of the Marquesas (lat. 25° 03′ 00″ N., long. 82° 13′ 00″ W.); 22 meters; temperature 19.44° C.; February 17, 1872. Dr. William Stimpson was the naturalist of the *Bache* on this cruise, and it is quite natural to suppose that specimens collected by him are of Pacific origin.

Hong Kong [Hartlaub, 1912] (fragment, M. C. Z., 445).

This specimen was probably one of Stimpson's from the Florida keys collected while he was naturalist of the *Bache.*

Geographical range.—From Cape Lookout, N. C., southward to Rio de Janeiro, Brazil.

Bathymetrical range.—From the shore line down to 508 (?510) meters. The average of 87 records is 193 meters.

Thermal range.—From 8.22° to 26.17° C. The average of 26 records is 17.78° C.

Remarks.—This species was first mentioned in 1840 as *Comatula echinoptera* by Prof. Johannes Müller, but only the distal intersyzygial interval was given. In the following year he described it in detail under the name of *Alecto echinoptera,* his type being a specimen in the Berlin Museum without locality data which had been deposited by Captain Wendt. He published a redescription of it in 1849 under the name of *Comatula* (*Alecto*) *echinoptera.*

In 1857 Prof. J. Victor Carus illustrated the spicules in the disk, his figure being republished by Bronn in 1860.

During his residence at Charleston, S. C., Prof. Louis Agassiz found a small comatulid to be quite abundant in that vicinity. His son, Mr. Alexander Agassiz, referred to it in 1864 under the name of *Comatula,* sp., and said that it carried its pentacrinoids on its cirri. In the following year Mrs. Elizabeth Cary Agassiz and Mr. Alexander Agassiz in their Seaside Studies briefly described this form, with figures of the adult and the pentacrinoids, as *Alecto meridionalis,* a manuscript name which had been given to it by Louis Agassiz.

In 1866 Prof. Addison E. Verrill suggested that this new species was possibly the same as the *Alectro dentata* which had been described by Thomas Say in 1825 from Great Egg Harbor, N. J.

In 1869 Count L. F. de Pourtalès recorded *meridionalis* from the dredgings of the United States Coast Survey west of Tortugas in 35 fathoms, and off French Reef in 45 fathoms, giving the color in life as purple or yellow, or both mixed. He referred to the original specimens from South Carolina, some of which were in the Museum of Comparative Zoölogy, and mentioned in connection with this species the name *Comatula holmesi,* which, however, he did not define.

In 1878 Pourtalès gave this species from *Blake* stations 32 and 45, and from off Cape Frio, Brazil, where it had been dredged by the *Hassler* on her voyage from the eastern to the western coast of the United States, and remarked that older and larger specimens look so much more massive than the young that they at first sight appear like different species, although the usual specific characters agree. One of the specimens which he recorded from lat. 25° 33′ N., long. 84° 21′ W., in 101 fathoms, has proved to be a small example of *Neocomatella pulchella*.

In his memoir on the Comasteridae (the genus *Actinometra* as understood by him) published in 1879 Dr. P. H. Carpenter assigned *meridionalis* (which he had not seen) to *Antedon* on the basis of the available descriptions. Müller's *echinoptera* he was unable to place, but on the strength of the marked comb described by Müller he tentatively assigned it to *Actinometra*, in spite of the fact that Müller said nothing about the position of the mouth.

In the autumn of 1880 Carpenter visited Berlin and was then able to examine the type specimen of *echinoptera*.

In his preliminary report upon the *Blake* comatulids published in 1881 Doctor Carpenter wrote that, although three-fourths of the species of Comasteridae from the Caribbean Sea are 10-armed, there is not one among them that recalls *solaris* of the eastern seas in which the elements of the IBr series and the first 2 brachials are united by syzygy. All of the 10-armed comasterids of the West Indies belong to a type which is but slightly represented in the Eastern Hemisphere—that of *Actinometra meridionalis*. In this type the elements of the IBr series and the first 2 brachials are united by synarthry and not by syzygy. Nearly all of the 10-armed comasterids in the Eastern Hemisphere belong to the *solaris* type, and the only exceptions known to him were *Actinometra cumingii* from Malacca and 2 or 3 undescribed species from China, Japan, and Sumatra.

He mentioned that the specimens which had been sent to the museums at Edinburgh and at Copenhagen under the name of [*Coccometra*] *hagenii* were varietal forms of *meridionalis*, and that 3 other species had been confused with *hagenii*. Similarly, he wrote, the specific designation *meridionalis* had been applied to almost every species with 10 arms and an excentric mouth, and even in two cases to forms with more than 10 arms, owing to some of the rays forking twice. All of these, he said, were true comasterids with combed oral pinnules.

He noted that Pourtalès seemed to think that the species varied considerably with age; but he said that almost all the characters given by the latter in his specific description would apply equally well to every 10-armed comasterid which has no syzygy in the IBr series, including those of the eastern seas, such as Müller's *cumingii*, and *echinoptera*, from an unknown locality, which are, nevertheless, perfectly distinct from *meridionalis* and from one another.

He therefore restricted the specific name *meridionalis* to the type from South Carolina upon which it had originally been conferred; but he wrote that the only example of it which had reached him was too imperfect for a satisfactory specific diagnosis to be framed from it, but it was valuable from the fact that it had two pentacrinoids entangled in its cirri.

He was inclined to agree with Count Pourtalès in thinking that the specimens from French Reef belong to the same type, and also those obtained by the *Hassler* off Cape Frio; but he remarked that the latter certainly constitute a strongly marked variety, as was indicated by Pourtalès on his labels, which differs from the French

Reef specimens in the character of the cirri and especially in the relative proportions of the lower pinnules.

He dissected the calices of both and found them to be so very similar that the differences between them can hardly be regarded as due to anything more than local variation. The radials of the French Reef specimens are relatively higher and slightly more sloping than those of the Cape Frio variety; but were these calices fossil specimens he said that he should have much hesitation in referring them to different species.

He noted, further, that several individuals in the very large collection from French Reef and a few individuals of the Cape Frio variety agree in possessing spherodes on the ungrooved posterior arms. But he remarked that in the *meridionalis* type, as in all the species of Comasteridae of which he had been able to examine any considerable number of individuals, the presence of ungrooved arms and of spherodes is altogether inconstant and irregular.

In his redescription of *Actinometra* [*Neocomatella*] *pulchella* he said that the 10-armed individuals belonging to this species are of the *meridionalis* type, with a synarthry between the elements of the IBr series.

The pentacrinoids from South Carolina he described in some detail, comparing them with those of *Antedon bifida* and *Hathrometra sarsii*.

He described a very young *meridionalis* with a relatively large well-combed pinnule on the second brachial and another fairly large pinnule on the eighth, while the intervening brachials have small or poorly developed pinnules, that of the fifth being either a mere stump or absent altogether.

From Carpenter's discussion it is evident that, as the natural result of his previous studies, which had to do chiefly with the multibrachiate Indo-Pacific types, his attention was almost entirely directed toward the characters presented by the arms, and he paid almost no attention to those afforded by the cirri, which organs have since been found to exhibit features of prime importance in the Comasteridae, especially in the 10-armed types. He laid particular stress on the syzygy between the elements of the IBr series in *Comatula solaris*, which in his mind indicated a very wide separation between the *solaris* and the *meridionalis* types. But it has been found that the slender-armed individuals of *solaris* and of the closely related *pectinata* do not have this syzygy developed, but instead these ossicles are united by a synarthry exactly as in *meridionalis*, though the union is much closer. The character upon which Carpenter depended to separate the *solaris* and the *meridionalis* types is therefore nonexistent, but it is the only one he ever mentioned. Müller's *cumingii*, one of his eastern species of the *meridionalis* type, has proved to be merely the young of *Comatula pectinata*.

In 1883 and again in 1884 in his memoirs on the myzostomes of the *Blake* and *Challenger* expeditions von Graff gave this species from several localities under the names (given him by Carpenter) *Actinometra meridionalis*, *Act. meridionalis* var. *quadrata*, and *Act. blakei; his Act. meridionalis* var. *carinata* is *Leptonemaster venustus*.

In the *Challenger* report upon the stalked crinoids published in 1884 Carpenter again discussed the occurrence of a synarthry, or, as he called it, a bifascial articulation, between the elements of the IBr series and between the first 2 brachials in *meridionalis*, and referred to the "Group of *Actinometra meridionalis*" within the genus *Actinometra*.

In 1888 in the *Challenger* report upon the comatulids Carpenter divided the genus *Actinometra* (the equivalent of the Comasteridae) into various "series," and these into different groups wholly on a basis of the characters presented by the arms. His Series I included those species in which a syzygy occurs between the elements of the IBr series and the first 2 brachials; the species with this feature which have only 10 arms constituted his "*Solaris* group." His Series II included species with "the two outer radials [i. e., the elements of the IBr series] articulated. Ten arms." This series included only the "*Echinoptera* group," the name *Echinoptera* replacing the name *Meridionalis* used for the group in 1884 on account of priority.

He had come to the conclusion that *echinoptera* is a Caribbean species, and not improbably identical with one of the many variations of *meridionalis*, which conclusion was strengthened by the fact—for which he was indebted to the kindness of Prof. E. von Martens—that the Berlin Museum also contains some other Caribbean echinoderms which were deposited by Captain Wendt.

As understood by him the *Echinoptera* group included 7 species, all but 2 of which are members of the Caribbean fauna. These species were:

1. *Echinoptera*.
2. *Meridionalis*.
3. *Blakei* (P. H. Carpenter, MS.).
4. *Pulchella* (the multibrachiate individuals falling in the *Stelligera* group).
5. *Rubiginosa* (he mentions that "tridistichate" series occasionally occur in this species, but does not place it in any other group).
6. *Cumingii* (subsequently found to be the young of *pectinata*, a member of the *Solaris* group).
7. *Coppingeri* (with 12 arms, and also placed in the *Fimbriata* group; this was subsequently found to be the young of *multiradiata*, of which *fimbriata* is a synonym).

In his discussion of *meridionalis*, which was obtained by the *Challenger* at Bahia, Brazil, in 7–20 fathoms, he said that before he received the *Blake* collection he had considered these specimens as representing a new species which he had called *Actinometra brasiliensis*, and this name appears on some of the plates which were printed off before he was able to examine specimens of undoubted *meridionalis*. For the present, he says, the type may be known under the name *meridionalis*, though it is quite possible that this may have to be discarded in favor of *echinoptera*.

In some of the *Challenger* specimens the dimorphism of the arms was very well marked, the posterior arms being ungrooved and consisting of but half the number of segments which occur in the anterior; but none of them possessed spherodes.

Hartlaub in 1891 wrote that the Comasteridae of the Western Hemisphere belong chiefly to the *Echinoptera* group, and said that Carpenter had written him that *echinoptera* is identical with the 10-armed variety of *pulchella*.

In 1902 Dr. Hubert Lyman Clark recorded this species from the *Fish Hawk* dredgings about Porto Rico under the names of *Actinometra meridionalis* and *Actinometra rubiginosa*.

In his elaborate memoir on the *Blake* comatulids published in 1912 Hartlaub stated that the *Blake* collection included three species of *Actinometra* (Comasteridae); but one of these he divided up into a great number of varieties and subvarieties.

In his work upon the Caribbean comatulids he followed undeviatingly the lines developed by Carpenter from his study of the East Indian types, in spite of the obvious fact that the interrelationships of the eastern and the western forms are radically different. Like Carpenter, he ignored the cirri and directed his attention almost wholly to the arms. He therefore entirely failed to notice that *echinoptera* is much more closely related to *solaris* and *pectinata* of the Indo-Pacific than it is to any of the other West Indian species, while all three show the same bewildering diversity in the length and stoutness of the arms.

Hartlaub's arrangement of the Caribbean species of Comasteridae, with their present determination, is as follows:

Actinometra echinoptera:

1. var. *echinoptera* ---------------- = *Comactinia echinoptera.*
   No locality.
2. var. *meridionalis* ---------------- = *Comactinia echinoptera;* but fig. 1, pl. 16, is *Leptonemaster venustus.*
   Blake stations 155, 156, 177, 203, 231, 247, 249, 272, 278, 297; French Reef; Cape Frio; Charlotte Harbor; Barbados; *Blake* station 30, 1880.
3. var. *valida* ---------------- = *Comactinia echinoptera.*
   Blake stations 157, 171, 219, 241, 277; Barbados, 100 fathoms.
4. var. *meridionalis-valida* ---------------- = *Comactinia echinoptera.*
   Blake stations 157, 246; St. Lucia, 278 fathoms.
5. var. *carinata* ---------------- = *Leptonemaster venustus.*
   Blake stations 127, 155, 177, 178, 203, 246, 249, 298; 10, 1880.
6. var. *meridionalis-carinata* ---------------- = *Comactinia echinoptera;* but one of the specimens from station 156 is *Leptonemaster venustus.*
   Blake stations 155, 156, 231, 286, 45; west of Tortugas.
7. var. *rubiginosa* ---------------- = *Nemaster rubiginosa;* but fig. 13, pl. 17, is *Comactinia echinoptera.*
   Blake station 155; Tortugas; Orange Key; the specimen figured in fig. 13, pl. 17, is from *Blake* station 157.
8. var. *meridionalis-rubiginosa* ---------------- = *Nemaster rubiginosa;* but fig. 6, pl. 17, from Montserrat, is *Comactinia echinoptera.*
   Blake stations 127, 155; Florida.

Actinometra echinoptera—Continued.

9. var. *pulchella:*

subvar. *pulchella* = *Neocomatella pulchella.*
Blake stations 134, 139, 148, 152, 156, 157, 158, 189, 206, 210, 216, 219, 224, 231, 232, 241, 249, 259, 269, 273, 277, 290, 294, 296, 298, 299; St. Lucia, 278 fathoms; 23° 32′ N., 88° 05′ W., 95 fathoms; 25° 33′ N., 84° 21′ W., 101 fathoms; between Martinique and Dominica, 160–380 fathoms; off La Chorrera, Cuba, 250 fathoms.

subvar. *alata* = *N. pulchella* var. *alata.*
Blake stations 224, 249, 269, 277, 294, 298; Barbados, 100 fathoms.

subvar. *planata* = *N. pulchella.*
Blake station 249.

10. var. *meridionalis-pulchella* = *N. pulchella.*
Blake station 287.

11. var. *discoidea* = *Nemaster discoidea;* but fig. 14, pl. 17, is *N. iowensis.*
Blake station 231.

12. var. *carinata-discoidea* = *Leptonemaster venustus.*
Blake station 246.

13. var. (?) *lineata* = *Nemaster iowensis* (the remarks quoted from Carpenter).

Actinometra blakei = *Comactinia echinoptera;* but the specimen described is *Nemaster iowensis.*

Actinometra cristata = *Comatonia cristata.*

In addition to the above, which he formally recognized, Hartlaub mentioned other varieties; these were:

Actinometra echinoptera:

var. *carinata-pulchella* = *Neocomatella pulchella.*
Blake station 155.

var. *carinata-rubiginosa* = *Nemaster rubiginosa.*
Blake station 155.

Actinometra echinoptera—Continued.
var. *rubiginosa-discoidea* = *Nemaster discoidea.*
Blake station 231.
var. *valida-meridionalis* = *Comactinia echinoptera.*
Blake station 272.
var. *aplanata* = *Neocomatella pulchella.*
No locality.
var. *multicirra* = *Nemaster iowensis;* Hartlaub gives this as the same as Carpenter's *blakei,* which is *Comactinia echinoptera.*

In 1918 Dr. H. L. Clark recorded numerous specimens of this species from off Habana, Cuba, in 110–200 fathoms which had been obtained by the University of Iowa's Bahama expedition in 1893, and in 1921 the present author listed it from various localities off Barbados, where it was found by the University of Iowa's Barbados-Antigua expedition in 1918.

Genus COMATULIDES A. H. Clark

Comanthus (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 221; Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366.

Cominia A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 497 (diagnosis; genotype *Comanthus decameros* A. H. Clark, 1908); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Comactiniinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 150 (off the Goto Is., 170 fathoms); p. 193 (probably occurs at Singapore); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 644 (compared with *Comissia*); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 725 (absent from Australia); p. 741 (closely related to *Comatula*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 389 (affinities and relations; closely allied to *Comatula* and to *Comactinia*); Crinoids of the Indian Ocean, 1912, p. 9 (does not occur in the area of maximum intensity of the East Indian fauna; absent from Australia); p. 10 (confined to Japan); p. 13 (corresponds to *Leptonemaster* and *Comatilia*); p. 20 (only known from the Korean Strait); p. 55 (in key); p. 83 (original reference; genotype); Beiträge zur Kenntnis d. Meeresfauna Westafrikas, Echinod. II, Crinoidea, 1914, p. 309 (corresponds, in part, to *Comactinia*); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetry).

Comatulides A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 24 (in key; range); p. 32 (key to the included species).

Diagnosis.—A genus of Comactiniinae including species in which the cirri are numerous, XXIV–XL, long and slender, strongly compressed laterally, and composed of not more than 20 segments, none of which are broader than long. The 10 arms are slender, gradually tapering distally, and never unusually attenuated in the outer portion. The IBr series are relatively long, narrow, and widely free laterally. The segments of the genital pinnules beyond the first 2 are not broadened, being as long as, or longer than, broad.

Geographical range.—From southwestern Japan to the Lesser Sunda Islands.

Bathymetrical range.—From 311 to 984 meters.

Remarks.—This curious and isolated genus bears much the same relationship to the other genera of Comactiniinae that *Comatilia, Comatonia,* and *Microcomatula* bear to the other genera of Capillasterinae, and, like them, it is a deep-water type.

KEY TO THE SPECIES OF THE GENUS COMATULIDES

a^1. Cirri XL, 16–17; division series and proximal portion of arms rugged, with strongly developed synarthrial and articular tubercles (southwestern Japan; 311 and ?731 meters).
decameros, p. 401.

a^2. Cirri XXII–XXIV, 12–15; division series and proximal portion of arms without synarthrial or articular tubercles (Lesser Sunda and Kei Islands; 520–984 meters)_______ australis, p. 403.

COMATULIDES DECAMEROS (A. H. Clark)

Plate 45, Figures 136, 137

[See also vol. 1, part 1, fig. 80 (dorsal view), p. 133; part 2, fig. 694 (disk), p. 341]

Comanthus decameros A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 221 (description; off the Goto Is., 170 fathoms); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 498 (made type of *Cominia*).

Cominia decameros A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 150 (off the Goto Is., 170 fathoms; superficial similarity to *Heliometra*); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 21 (compared with *Cominia australis*); Crinoids of the Indian Ocean, 1912, p. 20 (extends down to 170 fathoms); p. 83 (synonymy; record).

Comatulides decameros A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. IX (relationship with *C. australis*); p. 32 (in key; range); p. 33 (comparison with *C. australis*).

?*Comatulides decameros* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 31 (Bock's station 37; description).

Diagnostic features.—The cirri are XL, 16–17, and the division series and arm bases are rugged, with strongly developed synarthrial and articular tubercles.

Description.—The centrodorsal is discoidal, bearing numerous marginal cirri in roughly 3 irregular and crowded more or less alternating rows.

The cirri are XL, 16–17, long, slender, and delicate, 20 mm. in length. The first segment is very short, the second varies from slightly longer than broad to about twice as long as broad, the third-sixth are from two and one-half to three times as long as broad, and the following gradually decrease in length, so that the last two are about as long as broad. The opposing spine is represented by a low tubercle. The terminal claw is about as long as the penultimate segment and is moderately stout and moderately curved.

The ends of the basal rays are very prominent in the angles of the calyx.

The radials are concealed by the centrodorsal. The IBr_1 are short, oblong, and widely free laterally. The IBr_2 (axillaries) are broadly pentagonal, about twice as broad as long.

The 10 arms are 125 mm. in length. The first 7 or 8 brachials are slightly wedge-shaped, and those following become triangular and about as long as broad, and distally wedge-shaped again and longer. In the outer portion of the arms the brachials have projecting and finely spinous distal ends. The arms are rugged and tubercular basally, but are not enlarged or swollen.

Syzygies occur between brachials 3 + 4, again from between brachials 13 + 14 to between brachials 17 + 18 (usually nearer the former), and distally at intervals of from 3 to 5 (usually 3 or 4) muscular articulations.

P_1 is 23 mm., P_2 is 20 mm., P_3 is 15 mm., and P_4 is 10 mm. in length. The following pinnules increase gradually in length, reaching 22 mm. distally. The teeth on the terminal combs of the oral pinnules are low and rounded; combs do not occur beyond P_3. P_4 bears a gonad. The distal dorsal ends of the proximal segments of the first 4 or 5 pairs of pinnules are prominent, giving these pinnules a serrate dorsal profile basally. The distal ends of all the pinnule segments are projecting and finely spinous.

The color in alcohol is brownish yellow, with the cirri lighter and the perisome darker.

Remarks.—In its long and comparatively slender cirri and rugged arm bases this curious species presents a most remarkable similarity to species of the antedonid genus *Florometra.* Indeed, it is more likely to be confused with these species than with any of its close relatives.

Notes.—Dr. Torsten Gislén tentatively assigned to this species a young specimen from deep water in Sagami Bay, Japan, which he described as follows:

The cirri are XIX, 11–14, from 5 to 6 mm. in length. The fourth segment is the longest, two and one-half times as long as broad; the third and fifth segments are somewhat shorter. From the seventh segment onward a weak dorsal prominence is developed. The terminal claw is curved and pointed and is somewhat longer than the preceding segment.

The radials are very short, five times as broad as long, in the mid-radial line concealed by the centrodorsal. The IBr_1 are three times as broad as long, free laterally, and united to the IBr_2 by synarthry. The IBr_2 (axillaries) are low pentagonal, twice as broad as long.

The 10 arms are 35 mm. long. The first brachials are free interiorly and, like the second, somewhat shorter interiorly than exteriorly. The first 2 brachials are united by a close articulation. All of the brachials after the fourth are somewhat constricted centrally, with the distal edge everted and spinous. In their proximal portion the arms are rather narrow and are well separated from each other. The brachials distally are somewhat longer than broad.

Syzygies occur between brachials 3+4, 11+12, 15+16, and distally at intervals of 3 muscular articulations.

P_1 is 5 mm. long and is composed of 25 segments, of which 8–10 bear teeth; the tip of the pinnule is smooth, the segments not bearing teeth. P_2 and P_3 bear combs. The comb of P_a consists of 8 teeth. P_4 is 3 mm. long, with 11 segments and without a comb. P_7 is 4.2 mm. long, with 14 segments. The distal pinnules are 5 mm. long, with about 15 segments. The basal segments are short and spiny, the distal longer, half again as long as broad.

The disk is 5 mm. in diameter, swollen and somewhat elevated, without calcareous concretions, and clearly visible from the dorsal side in the broad interspaces between the arms; it reaches to the fourth brachial. The mouth and anal tube are subcentral, the latter being 2.5 mm. high.

Localities.—Off the Goto Islands, near Nagasaki, Japan (lat. 32° 22′ N., long. 128° 42′ E.); 311 meters [A. H. Clark, 1908, 1909, 1912, 1915, 1918] (1, C. M.). Pl. 45, figs. 136, 137.

?Dr. Sixten Bock's expedition to Japan station 37; off Okinose, Sagami Bay; 731 meters; July 8, 1914 [Gislén, 1922].

History.—This species was originally described in 1908 from a single specimen in the Zoological Museum at Copenhagen. In 1922 Dr. Torsten Gislén recorded a specimen which he tentatively referred to this species which had been collected by Dr. Sixten Bock in Sagami Bay in 1914.

COMATULIDES AUSTRALIS (A. H. Clark)

Plate 45, Figures 138, 139

Cominia australis A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 21 (description; *Siboga* station 297).

Comatulides australis A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. IX (relationship with *C. decameros*); p. 32 (in key; range; references; detailed description; stations 267, 297); p. 275 (listed); pl. 15, figs. 21, 22.

Diagnostic features.—This species differs from *C. decameros* in having fewer (XXIV) cirri which are composed of fewer (12–13) segments and are very slightly stouter and less strongly compressed distally; the synarthrial and articular tubercles are not so prominent as in *C. decameros*, but the rugged character of the arm bases is indicated, and might become prominent in larger examples.

Description.—The centrodorsal is thin discoidal, with the bare dorsal pole flat, 2 mm. in diameter. The cirrus sockets are arranged in three closely crowded roughly alternating marginal and submarginal rows.

The cirri are XXIV, 12–13, from 13 to 15 mm. long. The first segment is short, the second is nearly or quite twice as broad as long, the third is twice as long as the diameter of the ends, the fourth-sixth are three times as long as the median diameter, and the following decrease in length so that the antepenultimate is about one-third again as long as broad. The opposing spine is represented by a slight subterminal tubercle. The terminal claw is longer than the penultimate segment, rather stout, and moderately curved. The longer proximal cirrus segments have slightly swollen distal ends, this character gradually disappearing as the segments become shorter. The eighth or ninth segment becomes lighter in color distally, and is a slightly marked transition segment, though the preceding segments are smooth, like the following. The last 4 or 5 segments before the penultimate have their distal dorsal margin very slightly thickened. The cirri are moderately compressed laterally, this compression increasing slowly and uniformly from the base to the short outer segments.

The ends of the basal rays are very prominent as rounded tubercles in the interradial angles. The subradial clefts are very narrow and very deep.

The radials are concealed in the median line, being visible only at the side of and above the ends of the basal rays; their distal angles are separated by a prominent V-shaped gap. The IBr_1 are very short, slightly trapezoidal, narrower distally than basally, three times as broad as long, very widely separated laterally, the sides of adjacent IBr_1 making more than a right angle with each other. The IBr_2 (axillaries) are very broadly pentagonal, almost triangular, about twice as broad as long, their lateral edges about half as long as those of the IBr_1, with which they make slightly more than a right angle.

Arms 10, probably about 90 mm. long, resembling those of *C. decameros*, but not so rugged and with only mere traces of synarthrial and articular tubercles. The ossicles of the division series and the lower brachials are covered with fine dermal granulations.

P_1 is 15 mm. long, composed of 42 segments, of which the comb occupies 19, arising very gradually. The teeth of the comb are low, well separated, and well rounded distally, in height not reaching the lateral diameter of the segments which bear them. The second-fourth or -fifth segments of the pinnule have prominent and coarsely spinous ends. P_2 is 12 mm. long, similar to P_1 but smaller and proportionately less stout. P_3 is 7 mm. long, very slender, proportionately smaller and more slender than P_2. P_4 is 6.5 mm. long, slightly stouter than P_3, without a comb, and becoming very slender distally. The distal pinnules are 12 mm. long with 23 segments which have prominent articulations.

Localities.—*Siboga* station 297; off Rotti, southwest of Timor (lat. 10° 39′ 00″ S., long. 123° 40′ 00″ E.); 520 meters; soft gray mud with a brown superficial layer; January 27, 1900 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.). Pl. 45, figs. 138, 139.

Siboga station 267; off the southwesternmost of the Kei Islands (lat. 5° 54′ 00″ S., long. 132° 56′ 42″ E.); 984 meters; gray mud with a brown superficial layer; December 20, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 404).

Remarks.—As yet this species is only known from the two specimens dredged at widely separated stations by the *Siboga*.

Subfamily COMASTERINAE A. H. Clark

Comasterinae A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (includes *Comaster* and *Comanthus*); Die Fauna Sudwest-Australiens, vol. 3, Lief. 13, 1911, p. 438 (4 genera and 9 species in Australia); Crinoids of the Indian Ocean, 1912, p. 6 (subfamily exclusively confined to the East Indian region; number of genera and number of species); p. 20 (distribution in detail); p. 54 (in key); Bull. de l'Institut océanographique, Monaco, No. 294, 1914, pp. 7, 8 (relations to temperature); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical ranges); No. 20, p. 582 (relation to temperature); Records of the Western Australian Museum, vol. I, pt. 3, 1914, p. 114 (genus and species collected by the *Endeavour* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (bathymetrical range and its phylogenetic and palaeontological significance); Amer. Journal of Science, vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); Smithsonian Miscell. Coll., vol. 65, No. 10, 1915, p. 16 and following (phylogenetical study); Amer. Naturalist, vol. 49, 1915, p. 525 (bathymetrical and thermal ranges; component genera and their bathymetrical ranges); p. 539 (genera with asymmetrical disks; genera with one or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 1 (in key); p. 2 (in key); p. 34 (key to the included genera); University of Iowa, Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 14 (not represented in West Indies); Smithsonian Miscell. Coll., vol. 72, No. 7, 1921, p. 3.

Comastérinés A. H. Clark, Bull. du mus. d'hist. nat., Paris, No. 4, 1911, p. 247.

Diagnosis.—A subfamily of Comasteridae in which the cirri usually, but not always, bear dorsal spines or tubercles on the outer segments; the cirri may be well developed, and even large and stout, but are frequently small and weak and only partially and irregularly developed, or entirely absent; the arms are always more than 10 in number; all, most, or at least some of the division series are 4 (3+4), those not 4 (3+4), if such be present, being 2, or 2 (1+2); the first brachial syzygy is between brachials 3+4, with rarely a partially developed syzygy between brachials 1+2; the first brachial pinnule is always on the second brachial; and the genital pinnules are not especially stout, their component segments not noticeably short.

Geographical range.—From southern Japan eastward to Tokyo Bay, the Bonin, Pelew, Caroline, Gilbert, and Society Islands, Samoa, Tonga, Fiji, New Caledonia, New Zealand, Tasmania, and the southern coast of Australia westward to Baluchistan, the Seychelles, Madagascar, Natal, and the Cape of Good Hope as far as Simons and False Bays.

Bathymetrical range.—From the low-tide mark down to 548 meters. The relative frequency of the included genera at different depths is as follows:

0–100 meters	4
100–200 meters	4
200–300 meters	3
300–400 meters	1
400–550 meters	1

Remarks.—The subfamily Comasterinae is a very homogeneous group. All of the included species have more than 10 arms, and in some the number may be, in certain individuals, in excess of 150. Within fairly narrow limits the number of arms is constant in each species. While a very few of the species (as for instance *Comaster minima*) are small and delicate, several, including at least one in each genus, are of great size and massive structure.

The division series are always 4 (3+4) or 2, either (beyond the IBr series) exclusively 4 (3+4), or 4 (3+4) and 2 mixed in various proportions. The division series of 2 elements may occur in fixed and definite positions (as in *Comaster*, *Comantheria*, and *Comanthina*), or they may be irregularly scattered (as in *Comanthus*).

In one genus (*Comaster*) the synarthries in the division series and arm bases are usually replaced by syzygies. The first pinnule on the arms is always on the second brachial, and there is always a syzygy between brachials 3+4. All of the pinnules are always present, as in the Comactiniinae.

All of the included genera contain species in which the cirri are wholly absent, either invariably, frequently, or occasionally. These species are confined to the area bounded by the Philippine and Caroline Islands, tropical Australia, and the Maldive Islands. In one genus (*Comanthina*) all the included species are typically without cirri when adult, but all the other genera include species with numerous and well-developed cirri which may be small and weak (as in *Comanthus parvicirra*) but are usually large, and may be very large and stout (as in *Comanthus bennetti* and in *C. pinguis*).

The cirri have the distal segments shorter than the proximal, usually much shorter, and they are invariably, on all or at least some of the cirri, provided with dorsal processes.

Species without cirri, or with deficient cirri, are confined to the area bounded by the Philippine and Caroline Islands, tropical Australia, and westward to the Maldive Islands.

Gislén wrote (1922) that within the subfamily Comasterinae 3 different types of terminal combs can be distinguished. The first, which he called the *Comaster* type, is short and strongly rolled and composed of a few large teeth placed closely together. The combs occur on every second or third pinnule to rather far out on the arm. The second, the *Comanthus* type, has a greater number of teeth, which are small and low and therefore well separated. They become smaller proximally, and become obsolete toward the tip of the pinnule, leaving the latter smooth. The combs occur on a very few proximal pinnules—never further out on the arm than P_6—and are in a continuous series, never on every second or third pinnule as in the *Comaster* type. The third type, which to a certain extent is an intermediate one, is the subgenus *Comanthus* type, which has rather high and large teeth right out to the tip of the pinnule. As in the *Comanthus* type, the combs occur in an unbroken series.

Both the first 2 types are usually very definitely associated with certain genera within the subfamily Comasterinae. The *Comaster* type is found in the genus *Comaster*. The *Comanthus* type is, according to Gislén, characteristic of the genera *Comantheria*, *Comanthina(?)*, and the subgenus *Cenolia* in *Comanthus*.

But Gislén pointed out that in the subgenus *Comanthus* the use of this character, like so many others, becomes impossible.

To the subgenus *Comanthus* are assigned 2 forms, distinguished from each other by such an artificial character, in Gislén's opinion, as the number of arms. He believed the facts to be that *Comanthus timorensis* represents one group of forms with a generally greater number of longer and stouter arms, and *C. parvicirra* another group with a smaller number of more slender arms. But he said that both the so-called species vary so considerably that they intrude upon each other's spheres.

The specimens obtained by Bock show that within the subgenus *Comanthus* there occur combs of both the *Comaster* and the *Comanthus* types, and Mortensen's Japanese specimens show that combs of the subgenus *Comanthus* type occur also.

In reporting upon the Bock collection Gislén divided *Comanthus* (*Comanthus*) *parvicirra* into 2 subspecies, *comasteripinna* and *comanthipinna*, based upon the occurrence of the *Comaster* or the *Comanthus* type of comb. He said that he was neither able nor willing to discuss the innumerable synonyms of this species, and remarked that it is not possible to distribute the synonyms among the two new subspecies because most of the authors have given no information about the occurrence and appearance of the combs.

In his report upon the crinoids of Mjöberg's expedition he mentioned Carpenter's statement regarding the occurrence of the *Comaster* type of comb in 3 of the forms referred by the present author to the synonymy of *parvicirra*, namely, *Actinometra elongata*, *Act. simplex*, and *Act. quadrata*. All of Mjöberg's specimens, however, had 4 elements in the IIBr series and combs extending far out on the arms as in *Comaster;* so, trusting to the generic diagnoses of the present author, he referred the specimens, properly referable to *Comanthus* (*Comanthus*) *parvicirra*, to the genus *Comaster*, assigning the examples with stouter cirri to *Comaster multifida* and those with rudimentary cirri to *C. typica*. Since then he has been able to show that the occurrence of combs far out on the arms is not peculiar to the genus *Comaster*, but is characteristic of certain forms in the subgenus *Comanthus* in the genus *Comanthus*.

Gislén remarked that it is not strange that both of the species in the subgenus *Comanthus* have caused great trouble to all authors by their extreme variability in practically all diagnostic characters elsewhere successfully employed. Not only are the cirri and cirrus segments, division series and brachials, very variable in appearance and in number, but there are the added complexities arising from the varying development and distribution of the pinnule combs. In one of the specimens of *Comanthus timorensis* described by him the combs reached as far as P_{11}. In another specimen from Java combs occur on every other pinnule at least to P_{35}. This last he said has not been described, and possibly belongs to a new species because of the very long, slender, and well-separated arms.

Gislén said that it is possible that the two species of the subgenus *Comanthus* have become a rubbish heap for various species difficult of solution, or types inconvenient for the systematist. In such an event it would be possible to bring order into the now confusing multitude and to get a comprehension of the existing types by a detailed description of specimens. Characters that might perhaps be applied would be the number, or the presence or absence, of cirri, the width of the arm bases, the appearance and form of the brachials, of the division series, of the proximal and distal pinnules and their component segments, and of the disk, and also the features presented by the calcareous spicules. In other words, Gislén advocates a critical examination of all available characters in a large amount of material.

He suggested that possibly existing small species form hybrids between themselves and also cross with related species in the genera *Comaster* and *Comantheria* and in the subgenus *Cenolia*. He said that if these hybrids are fertile they will, after a couple of generations, be split into countless different types.

Supposing, for instance, that a form without cirri, with the IIIBr and IVBr series 4 (3+4), and with a comb of the *Comanthus* type, restricted to the proximal pinnules, were crossed with a form with cirri, with the IIIBr and IVBr series 2, and with combs of the *Comaster* type—short high combs extending on to the distal pinnules. Further, supposing that such a hybrid were fertile, and therefore in the second generation was normally split up into the different possibilities of recombination. Then one would get forms that might be referred to all the known genera within the subfamily Comasterinae. If, for instance, the first 3 genes as heterozygotic might be represented with different forms—rudimentary cirri, a mixture of 2 and 4 components in the IIIBr and IVBr series—one would get 108 different possibilities. The great variability in the division series, even in the same specimen, according to Gislén, seems to be proof of the probability of the heterozygotical nature of certain individuals of *Comanthus parvicirra*.

Gislén regarded the subgenus *Comanthus* as a very critical group, forming to a certain extent a connecting link between *Comantheria-Comanthus* (*Cenolia*) and *Comaster*. He said that the reason he did not unite all these genera was that he perceived the possibility of the subgenus *Comanthus* representing a rallying group of hybrids and hybrid splittings with combinations of characteristics from different form circles. He said that he should have liked to put the subgenus *Comanthus* as a separate genus between *Comaster* and *Comantheria-Comanthus* (*Cenolia*). In this case he would have distinguished it from *Comaster* by having the IIIBr series chiefly consisting of 4 elements, and from the two last by its having comb-bearing pinnules often occurring far out on the arms.

But he said that this would not be satisfactory if all the forms in the subgenus *Comanthus* of the *comanthipinna* type were not transferred to the subgenus *Cenolia*.

So he considered that it is for the present quite as good to retain the classification proposed by the present author.

He suggested as a rather good solution the division of the subfamily Comasterinae into 2 genera, *Comaster* and *Comanthus*, the first characterized by having combed pinnules occurring distally on every second or third segment, the second characterized by having the comb bearing pinnules in an unbroken series. With such a division the two types would be easy to keep apart if it were a question of closely related forms, for such forms are to be found no matter what division is made. He pointed out that in the same individual the combs seldom or never vary in the manner of their occurrence on different arms, and so to this extent they offer a better distinguishing feature than the division series. The subdivision proposed is still, however, impossible to carry out because of the incompleteness of the specific descriptions in regard to the appearance and the occurrence of the combs.

He said that to the first genus there might be referred *Comaster*, the subgenus *Comanthus* (part), and eventually *Comanthina* and *Comantheria* (part). To *Comanthus* in the new sense would be referred *Comantheria, Comanthina* (part), the subgenus *Cenolia*, and the subgenus *Comanthus* (part).

Although it is the largest of the subfamilies of the Comasteridae and the most abundantly represented in species and in individuals wherever it occurs, this subfamily is the most restricted in its range both geographically and bathymetrically. It is not found in the Atlantic, where species of Capillasterinae occur on both the eastern and western sides and where a species of Comactiniinae is very abundant along the western shores, and it does not descend below 548 meters. Its range in Polynesia, however, on the basis of the available information, would seem to be much more extensive than that of the other two subfamilies. But this undoubtedly is due to insufficient knowledge.

History.—The subfamily Comasterinae was established in 1909 to include the genera *Comaster* and *Comanthus*. The genera *Comantheria* and *Comanthina* were subsequently established—originally as subgenera—to include groups of species which previously had been referred to *Comanthus*.

The Comasterinae include all the species referred by Dr. P. H. Carpenter to the *Typica* group (all of which fall in the genus *Comaster*), all of those placed by him in the *Valida* group (which are merely individual variants of *Comanthus timorensis* or of *C. parvicirra*, also placed, under the names *parvicirra*, *quadrata*, and *littoralis*, in the *Parvicirra* group), and all of the species referred to the *Parvicirra* group (which are distributed among the genera *Comaster*, *Comantheria*, *Comanthina*, and *Comanthus*).

KEY TO THE GENERA OF THE SUBFAMILY COMASTERINAE

a^1. Elements of the IBr series and first 2 ossicles following each axillary united by syzygy; IIBr series 4 (1+2, 3+4), or partly 4 (1+2, 3+4) and partly 2 (1+2); IIIBr and succeeding division series 2 (1+2), only very exceptionally of 4 elements; in large species the IIBr and following axillaries typically bear a division series on one face and an undivided arm on the other, so that the IIBr (more rarely IIIBr) axillary is the base of a stout trunk composed of division series giving off arms on alternate sides; this feature serves to identify the young of large species in which the 2 ossicles following each axillary are still united by synarthry

(Maldive Islands to Australia, south to Port Walcott, Western Australia, and Port Molle, Queensland, Fiji, the Gilbert [Kingsmill] Islands, southern Japan, the Philippines, Macclesfield Bank, and the coast of China; 0–290 [?538] meters) ---------------- **Comaster**, p. 409.

a^2. Elements of the IBr series and first 2 ossicles following each axillary united by synarthry; most of the axillaries bear either 2 division series or 2 arms; there is never a series of successive division series bearing alternately a further division series on one side and an undivided arm on the other.

- b^1. All of the IIIBr series 2; only very exceptionally are IIIBr 4 (3+4) series to be found following IIBr 2 series, particularly on the posterior arms; IIBr series all, or mostly, 4 (3+4); some, most, or all of the division series following the IIIBr series 4 (3+4) (Java to Australia, south to the Abrolhos Islands, Western Australia, and Ballina, New South Wales, the Bonin Islands, southern Japan, the Philippines, Formosa [Taiwan], and Fukien Province, China; 0–150 meters) ---------- ---------------------- **Comantheria**, p. 483.
- b^2. All, most, or at least some of the IIIBr series 4 (3+4).
  - c^1. Outer IIIBr series on each ray 2, the inner 4 (3+4); following division series wholly, or mostly, 4 (3+4); IIBr series wholly, or mostly, 4 (3+4); the typical arrangement of the IIIBr series is subject to some variation, on the posterior arms especially, following IIBr 2 series; but it is always evident on at least one of the rays (Maldive Islands and Ceylon to Australia, south to the Abrolhos Islands, Western Australia, and Torres Strait, the Solomon, Caroline, and Philippine Islands, and Macclesfield Bank; 0–548 meters) -- **Comanthina**, p. 457.
  - c^2. IIIBr series, either all 4 (3+4), or 4 (3+4) and 2 in varying proportions; in the latter case there is never any definite arrangement of the 4 (3+4) and 2 series (Cape of Good Hope, Madagascar, the Seychelles and Baluchistan to Australia, including the whole southern coast, Tasmania, New Zealand, New Caledonia, Fiji, Tonga, Samoa, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, the Philippines, Hong Kong, and Amoy, China; 0–256 [?548] meters) ---------------------------- **Comanthus**, p. 527.

Genus COMASTER L. Agassiz

?*Alecto* Leach, Zool. Miscell., vol. 2, 1815, p. 61 (diagnosis; first species *A. horrida*, not recognizable).—Leach, Zool. Journ., vol. 1, 1825, p. 589.

?*Polyactis* Rafinesque, Analyse de la nature, 1815, p. 153 (no type given).

?*Heterias* Rafinesque, Analyse de la nature, 1815, p. 153 (no type given).

Comatula (part) Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 534 and following authors.

Comaster L. Agassiz, Mém. soc. de sci. nat. de Neuchâtel, vol. 1, 1835, 1836, p. 193 (diagnosis; genotype *Comatula multiradiata* Lamarck, 1816).—Lamarck, Hist. nat. des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 472.—Goldfuss, Nova Acta Acad. German., vol. 19, 1839, p. 349.—Lamarck, Hist. nat. des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 212.—J. Müller, Archiv f. Naturgesch., 1840, vol. 1, p. 309; Monatsber. d. k. preuss. Akad. d. Wiss., April, 1840, p. 93; Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 203.—[Gervais], Dict. univers. d'hist. nat., vol. 4, 1844, p. 130.—Gistel, Naturgesch. des Thierreichs, 1848, p. 176.—Quenstedt, Handb. d. Petrefactenkunde, 1852, p. 600.—de Koninck and le Hon. Mém. acad. roy. de Belgique, 1854, p. 46.—Bronn, Die Klassen u. Ordnungen d. Strahlenthiere, 1860, p. 202 (history).—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 211 (history).—Carus, Handb. d. Zool., vol. 2, 1863, p. 515.—Allman, Trans. Roy. Soc. Edinburgh, vol. 23, 1864, p. 246.—M. Sars, Mémoire pour servire a la connaisance des crinoïdes vivants, 1868, p. 2.—Pomel, Revue des échinodèrmes, [1869], p. lii.—P. H. Carpenter, Nature, vol. 15, Jan. 4, 1877, p. 197; Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 455.—Quenstedt, Petrefactenkunde Deutschlands, vol. 4, Asteriden u. Encriniden, 1876, p. 165.—Packard, Zoology, 1879, p. 101.—Zittel, Handb. d. Palaeontol., vol. 1, 1876–1880, p. 396.—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 7 (history); Quart. Journ. Geol. Soc., 1880, p. 40; Journ. Linn. Soc. (Zool.), vol. 15, 1880, pp. 188 and following; Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 166; Report Brit. Assoc. for 1881 (York), 1882, p. 672.—Chapman, Trans. Roy. Soc. Canada, vol. 1, 1882, sect. 4, 1883, p. 115.—Packard, Zoology, 1886, p. 101.—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, No. 40, April 1891, pp. 386, 387 (discussion).—Bather, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 464.—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 8, No. 44, Aug. 1891, pp. 180, 181.—Seeliger, Zool. Jahrb., Anat. u. Ontog., vol. 6, 1892, p. 394.—Huxley, Anat. of Invert. Animals, 1901, p. 498.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (restored to use with the type *Asterias multiradiata* Linné; diagnosis and list of species); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 135 (referred to the Comasteridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Comasteridae); p. 212 (occurs in the West Indies and Japan); p. 506 (status; type *Asterias multiradiata* Linné); vol. 35, 1908, pp. 113, 114; fig. 24, p. 122 (arm structure); p. 123 (restriction; diagnosis); p. 124 (list of species); pp. 126, 127 (arm structure); American Naturalist, vol. 42, No. 500, 1908, p. 541 (characteristic of the Indo-Pacific-Japanese area); Geographical Journal, vol. 32, No. 6, 1908, p. 602 (same); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 204 (distinctive characters); p. 207 (compared with *Comatella*); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (type determined as *Comatula multiradiata* Lamarck [not *Asterias multiradiata* Linné] = *Alecto multifida* J. Müller); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 362 (ambulacral plating in the genus [that is, *Nemaster*] first shown by Springer; constant feature in all West Indian species); p. 365 (mouth nearly or quite central); p. 506 (synonymy; genotype; distribution); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 173 (articulation in the IBr series a pseudosyzygy); p. 175 (referred to the Comasterinae); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 538 (articulation in IBr series); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 711 (determination of the genotype); pp. 730, 732 (in key); p. 733 (key to the Australian species); p. 746 (original reference, characters, and range); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 6 (*Actinometra belli* referred to this genus); Crinoids of the Indian Ocean, 1912, p. 2 (a species was included by Lamarck in his *Comatula multiradiata*); p. 9 (possesses additional species in Australia); p. 11 (represented in the Ceylon region; this the western limit of the large and highly multibrachiate species); p. 55 (in key); p. 83 (original reference; type); Smiths. Miscell. Coll., vol. 65, No. 10, 1915, pp. 34 and following (phylogenetic study); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk; 1 or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 34 (in key; range); p. 35 (key to the included species).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 52 (pinnule combs); p. 56 (discussion); Zool. Bidrag från Uppsala, vol. 9, 1924, p. 35 (brachial homologies); p. 84 (pseudosyzygies); p. 88 (articulations); p. 97 (pinnule articulations); p. 117 (relation to fossils).

Phanogenia Lovén, Öfversigt k. Vetensk.-Akad. Förhandl., 1866, No. 9, p. 231 (diagnosis; genotype *Ph. typica*).—Claus, Grundzüge d. Zool., 1872, p. 229 (a recent type); p. 230 (listed); 1876, pp. 277, 279.—P. H. Carpenter, Nature, vol. 15, Jan. 4, 1877, p. 197; Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 442.—Pascoe, Zool. Classification, 1877, p. 30.—Zittel, Handb. d. Palaeontol., vol. 1, 1876–1880, p. 346 (referred to the Comatulidae); p. 397 (a recent type).—P. H. Carpenter, Quart. Journ. Microsc. Sci., new ser., vol. 18, 1878, p. 361 (basals); Proc. Roy. Soc., vol. 28, 1879, p. 389; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 16 (listed); Quart. Journ. Geol. Soc., 1880, p. 40.—Claus, Traité de zool., 1884, p. 412.—von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, p. 29.—de Loriol, Paléontol. franç., terrain jurassique, vol. 11, pt. 2, 1889, p. 432.—Springer, Mem. Mus. Comp. Zoöl., vol. 25, No. 1, 1901, p. 51.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (considered a synonym of *Comaster* [as here used]); vol. 35, 1908, fig. 20, p. 120 (arm structure); p. 123 (reinstated; diagnosis); p. 124 (list of species); p. 127 (arm structure); American Naturalist, vol. 42, No. 500, 1908, p. 541 (characteristic of the Indo-Pacific-Japanese area); Geographical Journal, vol. 32, No. 6, 1908, p. 602 (same); Smiths. Miscell. Coll., vol. 52, p. 2, 1908, p. 203 (redefined and restricted); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (as a generic name must be supplanted by *Comaster*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (mouth nearly or quite central).

Actinometra (part) Lütken, Mus. Godeffroy Cat., vol. 5, 1879, pp. 386, 390, and following authors.

Antedon (part) Hartlaub, Nachr. Ges. Göttingen, May, 1890, p. 187; Bell, Proc. Zool. Soc. London, 1894, p. 400; Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 224.

Comanthina (part) A. H. Clark, American Journ. Sci., ser. 4, vol. 32 (old ser., vol. 182), 1911, p. 130.

Comantheria (part) A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, pp. 716, 723.

Diagnosis.—A genus of Comasterinae in which the elements of the IBr series and the first 2 ossicles following each axillary are united by syzygy; the IIBr series are 4 (1+2, 3+4), more rarely partly 4 (1+2, 3+4) and partly 2 (1+2); the IIIBr and later division series are 2 (1+2) or, very exceptionally, of 4 elements; terminal combs are not confined to the proximal pinnules, but are found at more or less frequent intervals on the middle and distal pinnules.

Geographical range.—From China, southern Japan, the Philippine, Gilbert, and Society Islands, Fiji, and Australia, south to Port Molle, Queensland, and Port Walcott, Western Australia, westward to the Maldive Islands.

Bathymetrical range.—From the shore line down to 290 (?538) meters. Of the 12 species, 11 occur in 0–100 meters, 5 in 100–150 meters, 3 in 150–200 meters, and 2 are found in depths greater than 200 meters.

Remarks.—The species of this genus all have a great development of small spines on the brachials and especially on the pinnule segments, so that they have a characteristic "feel." But a similar "feel" is possessed by *Comanthus samoana* and by some forms of *Comanthus parvicirra*.

They also have a very characteristic appearance. The arms are very slender and the elements of the division series and the lower brachials usually have the sides distinctly concave. The edges of the elements of the division series, including those bordering the syzygial lines, are, excepting in the very largest specimens, rather prominently spinous.

Excepting in *C. multifida* the color is almost invariably more or less bright yellow, with a narrow median dark stripe on the division series and arm bases. But this type of coloration is not entirely constant, for *C. brevicirra* (=*parvus*) is sometimes black with yellow pinnule tips. *C. multifida* is variously colored (see vol. 1, pt. 2, p. 706), but apparently this species is never yellow, or at least wholly, when fully grown.

In the very large species of *Comaster* the IIBr and following axillaries typically bear a division series on one face and an undivided arm on the other, and the division series and undivided arms alternate in position on succeeding axillaries. This gives the appearance of 2 stout arm trunks on each ray, of which the IIBr series are the bases from which, on every other ossicle, an undivided arm arises, the successive arms alternating in position, the first being external, the second internal or adradial, the third external again, and so on. More rarely the IIIBr series serve as the bases of these arm trunks, in which case there are 4 to each ray. Division series which occur out of the regular order, as on the side branches from these main trunks where one would expect an undivided arm, are usually of 4 elements instead of the usual 2.

This very characteristic arrangement of the division series whereby 2 main arm trunks arise from each IBr (more rarely from each IIBr) axillary recall the conditions in the large species of *Comatella*. But in *Comatella* the undivided arms are given off only on the inner or adradial side of the arm trunks, while in *Comaster* they arise first on one side and then on the other.

The number of arms varies from 20 in *C. tenella* to 160 or more in *C. multibrachiata* and about the same number in *C. multifida*. In *C. multifida* the number of arms seems to vary within rather wide limits, but in the other species it is remarkably constant.

The proximal pinnules are small and very slender, with abruptly differentiated terminal combs usually composed of relatively few very large teeth which are commonly, in preserved specimens, rolled into a ball. Terminal combs are not confined to the proximal pinnules, but are found at intervals on the middle and distal pinnules. This distribution of terminal combs is not confined, however, to *Comaster*, though elsewhere it is confined to individual variants in certain species.

Of the 12 included species, 9 invariably possess well-developed and more or less numerous cirri, while in 3—one very large, one of medium size, and one small—the centrodorsal is wholly without cirri and is reduced to a small stellate plate lying within the radial pentagon.

The several species of *Comaster* are undoubtedly much more common than would appear from the records. They are all extremely brittle, and in the majority of the individuals collected the proximal syzygies break through immediately after, or even during, capture, rendering them, if taken in the usual way, scarcely worth the trouble of preserving.

KEY TO THE SPECIES IN THE GENUS COMASTER

a^1. Cirri absent; or if any cirri are present they are weak and poorly developed and are irregularly distributed about the periphery of the much-reduced centrodorsal.

b^1. Size usually large; division series stout and massive; no black mediodorsal line; 45–130, but usually more than 80, arms; interbrachial perisome usually heavily plated (Singapore to northwestern Australia, New Guinea, New Britain, and the Fiji, Gilbert, and Philippine Islands; 0–91 meters) ---------- **multifida, p. 413.**

b^2. Size smaller; division series more slender; a conspicuous black mediodorsal line; no interbrachial plating.

c^1. Size moderate; more than 40 (40–80, usually 40–60) arms (Maldive Islands to New Britain, Fiji, and the Macclesfield Bank; 0–55 meters) ---------- **gracilis, p. 430.**

c^2. Small and exceedingly slender and delicate; less than 40 arms (Sunda Islands to northern Australia and the Philippines; 24[?9]–216 meters) ---------- **minima, p. 435.**

a^2. Cirri present, well developed, and occurring in an uninterrupted marginal row or rows.

b^1. Arms 140–160 in number; cirri numerous, large and stout, with 13–16 segments (Andaman and Lesser Sunda Islands to the Philippines; 31[?9]–55 [?538] meters) **multibrachiata, p. 437.**

b^2. Not more than 65 arms.

c^1. More than 40 arms.

d^1. Cirri short and stout, their length not more than one-tenth of the arm length; longest cirrus segments not more than three times as long as the median width; antepenultimate segment never longer than broad, and penultimate segment broader than long.

e^1. Cirrus segments 8–11, the longest (third) three times as long as the median width; those following decrease in length, so that the antepenultimate is about as long as broad and the penultimate is slightly broader than long; the fourth and following have slight dorsal processes; arms 37–63 in number, 90 mm. long (Lesser Sunda Islands to the Philippines; 35[?27]–106 meters) ---------- **fruticosus, p. 440.**

e^2. Cirrus segments 12–13, the longest (third-fifth) half again as long as broad, or at most only slightly longer; seventh and following with slightly everted distal dorsal ends; ninth or tenth and following broader than long; arms 60 in number, 150 mm. long (China; Singapore) ---------- **schönovi, p. 443.**

d^2. Cirri longer and more slender, more than one-tenth of the arm length; longest cirrus segment (third) from three to three and one-half times as long as the median width, those following rapidly becoming shorter, so that the antepenultimate is slightly longer than broad and the penultimate is about as long as broad; the sixth and following have sharp and prominent dorsal processes; 60 arms (Java Sea; 88 meters). sibogae, p. 442.

c^2. Not more than 40 arms.

d^1. Arms 35–40 in number.

e^1. Cirri with 10–12 segments, 8 mm. long; arms 60–70 mm. long (Andaman, Lesser Sunda, and Aru Islands and the Moluccas to the Macclesfield Bank and southern Japan; 15 [?9]–110 meters) ---------------------------------- brevicirra, p. 444.

e^2. Cirri with 15–17 segments, 12–15 mm. long; arms 85 mm. long (Kei Islands; 0–52 meters) --- pulcher, p. 443.

d^2. Less than 35 arms.

e^1. Arms 30–35 in number.

f^1. Longest cirrus segment (fourth) about twice as long as broad; cirri VIII–XXIII, 9–13; 30–33 arms 80–100 mm. long (Lesser Sunda Islands to New Guinea, and northward to the Philippines; 18–290 [?400] meters) ----------- distincta, p. 448.

f^2. Longest cirrus segments (third and fourth) three times as long as broad; cirri XV, 10; 30 arms (southern Japan; 100–174 [?210] meters) ----------- serrata, p. 451.

e^2. Arms 20 in number; cirri XII, 10–11, the longest segments about two and one-half times as long as broad; cirri weak and rather slender; arms 65 mm. long (Singapore to the Kei Islands; 0–90 meters) -------------------------------- tenella, p. 455.

COMASTER MULTIFIDA (J. Müller)

Plate 46, Figures 140, 141

[See also vol. 1, part 2, figs. 148–151 (analysis of arm structure), p. 83; fig. 695 (disk), p. 341; pl. 9, fig. 1023 (analysis of division series)]

Comatula multiradiata Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 534.—de Blainville, Dict. des sci. nat., vol. 10, 1818, p. 108 (from Lamarck).—Lamouroux, Encyclop. méthodique, vol. 2, 1824, p. 205 (from Lamarck).—de Blainville, Dict. des sci. nat., vol. 60, 1830, p. 229 (from Lamarck).—Oken, Allgem. Naturgesch., vol. 5, Abt. 2, 1835, p. 594 (from Lamarck).—de Blainville, Manuel d'actinologie, 1834, 1836, p. 249 (from Lamarck).—Dujardin, in Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 3, vol. 1, 1837, p. 470 (from Lamarck).—Deshayes and Milne-Edwards, Hist. nat. des animaux sans vertèbres, ed. 2, vol. 3, 1840, p. 209 (from Lamarck).—J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 180 (structure).—[Gervais], Dict. universel d'hist. nat., vol. 4, 1844, p. 130 (from de Blainville).—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, No. 40, April, 1891, pp. 386, 387 (type of *Comaster*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 444 (identity); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (identity; identification by Müller as *Alecto multifida*); Crinoids of the Indian Ocean, 1912, pp. 2, 29 (of Lamarck, 1816, includes *Comaster multifida*, *Capillaster sentosa*, and *Comanthus bennetti*).

Comaster multiradiatus L. Agassiz, Mém. soc. de sci. nat. Neuchâtel, vol. 1, 1835, 1836, p. 193.—de Loriol, Paléontol. franç., ter. jurassique, vol. 11, pt. 2, 1889, p. 437 (after Agassiz).—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 387 (type of *Comaster*).

Alecto novae-guineae J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 186 (description; Eidouma); Archiv f. Naturgesch., 1841, vol. 1, p. 146 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 216.—A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (notes on the type); Memoirs Australian Mus., vol. 4, No. 15, 1911, p. 748 (placed in the *Typica* group by Carpenter).

Alecto multifida J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 188 (new name conferred upon the specimens described as *Comatula multiradiata* by Lamarck); Archiv f. Naturgesch., 1841, vol. 1, p. 144 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 216 (structure).—Berthold, Lehrb. d. Zool., 1845, p. 528 (from Müller).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 444, 452 (same as *Comatula multiradiata* Lamarck, which is the same as *Asterias multiradiata* Linné [error]); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (=*Comatula multiradiata* Lamarck [which is not *Asterias multiradiata* Linné] reidentified); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 396 (near *Phanogenia typica*); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (=*Comatula multiradiata* Lamarck, in part; that is, minus *Capillaster sentosa* and *Comanthus bennetti*).

Comatula multifida J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 188 (same as *Alecto multifida*); Archiv f. Naturgesch., 1841, vol. 1, p. 147 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 262 (redescription).—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 207 (synonymy; description; Indian Seas).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Comatula novae-guineae J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 264 (redescribed).—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 208 (synonymy; description; New Guinea).—Kuhl and van Hasselt, in Herklots, Bijdragen tot de Dierkunde, 13 Afl., 1869, p. 11, pl. 10.—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (unable to place either in *Antedon* or in *Actinometra*).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 31 (identity).

Alecto multiradiata (part) Troschel and Ruthe, Handb. d. Zool., 1859, p. 584 (after J. Müller).

Phanogenia typica Lovén, Öfversigt k. Vetensk.-Akad. Förhandl., 1866, No. 9, p. 231 (description; New Harbour, near Singapore; shallows and muddy places); fig., p. 230, *a–h*.—Claus, Grundzüge d. Zool., 1872, p. 230 (example of the genus); 1876, p. 279 (same).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 20 (characters, as described by Lovén); Proc. Roy. Soc., vol. 28, 1879, p. 389.—Claus, Traité de zool., 1884, p. 412.—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, p. 234, footnote (from Lovén).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203 (*Albatross* Sta. 5138; arm structure); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (this species, the type of *Phanogenia*, is closely related to *Alecto multifida*, the type of the prior genus *Comaster;* therefore *Phanogenia* is not available as a generic name).—A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 748 (placed in the *Typica* group by Carpenter); Crinoids of the Indian Ocean, 1912, p. 3 (history).

Actinometra stellata Lütken, Mus. Godeffroy Cat., vol. 5, 1874, p. 190 (Fiji; *nomen nudum*).—P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, pp. 386, 390 (centrodorsal); Quart. Journ. Geol. Soc., 1880, p. 51 (same); Notes from the Leyden Mus., vol. 3, 1881, p. 195 (Fiji; synonym of *typica*); *Challenger* Reports, Zoology, vol. 11, p. 32, 1884, pp. 132, 319; vol. 26, pt. 60, 1888, pp. 296, 297.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 447 (history); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (synonym of *typica*); Notes from the Leyden Mus., vol. 33, 1911, p. 178 (=*Comaster typica;* specimen from Fiji compared with the type of *novae-guineae*).

Comatula, sp. (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 23, footnote 5.

Actinometra multifida P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 22 (interbrachial plates); p. 27 (systematic position); p. 28 (arm division; correction of Müller).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed); p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 740 and following (discussion of Bell's method of formulation, and corrected formula).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 169 (Percy I.; Albany Island; Prince of Wales Channel).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 44, 48, 58, 329, 330, 333, 367, 382 (Queensland; Torres Straits; characters).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 444 (history); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 714

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Diagnostic features.—Large and robust, with the division series broad and massive and the interbrachial perisome usually heavily plated. The arms average 80 in number, and are usually considerably more in fully grown individuals. There is no conspicuous dark mediodorsal line on the division series and arms, though an indistinct trace of such a line may be present. The centrodorsal is greatly reduced, stellate, with no trace of cirri in the fully grown animal; in the young when cirri are present they are few in number and irregularly distributed about the margin of the centrodorsal.

Notes.—The specimen from New Harbour described and figured by Professor Lovén has 80 arms. The IIBr series are 4 (3+4), each bearing 2 IIIBr 2 (1+2) series. The IIIBr series bear externally an undivided arm, and internally a IVBr 2 (1+2) series. The IVBr series bear an undivided arm and a VBr 2 (1+2) series, the position of these being reversed in reference to the division series and undivided arm preceding. The VBr series bear 2 undivided arms.

The IIIBr and all subsequent axillaries therefore carry one division series and an undivided arm which alternate in position on succeeding axillaries, the first of the undivided arms (that on the IIIBr axillary) being always external in reference to the IIBr series.

The centrodorsal is greatly reduced, stellate, and flush with the radial ring. There are about VIII rudimentary cirri irregularly situated in the radial areas.

The radius of the centrodorsal is 1.3 mm. The radius of the radial pentagon is 2.5 mm. The distance from the middle of the centrodorsal to the apex of the IBr axillary is 5.8 mm. The IIBr series are 5.2 mm. long. The IIIBr series are 2 mm. long. The IVBr series are 2 mm. long, and the VBr series are 1.8 mm. long. The undivided arms are 110 mm. long. The distance from the middle of the centrodorsal to the arm tips is 126.8 mm.

The specimen from the Danish expedition to the Kei Islands station 37 has about 150 arms. The centrodorsal is a thin disk, rounded pentagonal, with XII cirri of various sizes, though none fully developed; the largest is 13 mm. long with 14 segments, slender and straight.

In the specimen from the Moluccas which served Müller as the type of his *Alecto multifida* there are 45 arms. The typical scheme of arm division is as follows: There are 10 IIBr 4 (3+4) series. Each of these carries externally a IIIBr 2 series and internally an undivided arm; the IIIBr series bears externally an undivided arm and internally a IVBr 2 series. The IVBr series carries 2 undivided arms. As in Lovén's specimen from New Harbour and in the Copenhagen specimen from Fiji, the general effect is of 2 stout arm trunks giving off arms which are alternately internal and external. But while in the specimens from New Harbour and Fiji there are 2 of these arm trunks arising from each IIBr axillary, and therefore 4 to each postradial series, in the specimen under consideration the arm trunks arise from the IBr axillaries, and there are therefore only 2 to each ray. One of the IIIBr series is 4 (3+4). There are 8 IVBr series, all of 2 ossicles and all internally developed. There is a single VBr 2 series.

The elements of the IIIBr series are united by what appears to be a close synarthry which has not become transformed into a syzygy. This is probably what misled Carpenter and caused him to place this species in the *Parvicirra* group instead of in the *Typica* group, where it belongs.

The division series are broad, and the interradial perisomic areas are completely and heavily plated.

There were about XV cirri present in life, the stumps remaining showing that the cirri were stout.

The specimen from *Siboga* station 89 has the arms 80 mm. long. There are 5 or 6 postradial axillaries.

The example from Maumeri has the arms 75 mm. long and 4 or 5 postradial axillaries.

The specimens from Ternate are both small.

The individual collected by the *Siboga* at Amboina has the arms 85 mm. long and 5 or 6 postradial axillaries.

Hartlaub remarked that in neither of the specimens which were collected by Doctor Brock at Amboina is there a trace of cirri on the centrodorsal, the latter lying almost beneath the level of the radial ring.

The rays divide usually five times, and never more than seven times. In one specimen all the IIBr series are 4 (3+4); in the other 8 of the IIBr series are 4 (3+4) and 2 are 2. In the first specimen all the IIIBr series are 2, while in the second one of the rays has the 2 outermost IIIBr series 4 (3+4), but all the others are 2. In the first specimen 18 out of the 20 IIIBr series bear interiorly, in reference to the IIBr series, a IVBr 2 series and outwardly an undivided arm. The other 2 bear an external as well as an internal IVBr series, which in one case is 4 (3+4) and in the other case 2. In the second specimen 12 of the IIIBr series bear a IVBr 2 series internally in reference to the IIBr series and externally an undivided arm. Two of the IIIBr series, both external in reference to the IBr series, bear 2 undivided arms, and 6 bear a IVBr 2 series internally and a IVBr 4 (3+4) series externally.

Hartlaub noted that the IVBr series may be 4 (3+4), or sometimes 3. He also remarked that when the IIBr series, which are normally 4 (3+4), are of 2 ossicles the outer division series also are irregular.

The pinnules of the first 2 pairs are of almost equal length, but those of the second pair are often the longer. The pinnules of the 3 following pairs are markedly shorter and are exceedingly slender. Hartlaub said that in this respect his specimens seemed not to be wholly in agreement with those recorded by Carpenter, for the latter wrote that those of the first pair are the longest, those of the second pair shorter, and the length of those following decreases.

The arm length of these 2 specimens is about 200 mm. Hartlaub remarked that the unusual length of the arms is very remarkable, as Carpenter described the arms as short; he suspected that in Carpenter's specimens the arms were not preserved for their full length. The distal portion of the arms is exceedingly slender, so that if they are broken their length may easily be underestimated.

Hartlaub observed that the syzygial nature of the union of the elements of the IBr series is debatable. The articulation described by Carpenter as syzygial Lovén considered as a synarthry, and Hartlaub said that after a careful study of the case he might adopt this latter view. He remarked that the radial sculpture characteristic of all syzygial joint faces is lacking, but instead, as is also the case with the articulation between the first 2 elements of the IIBr series, there are prominent concentric ridges, and in the dorsoventral line a joint axis in the form of an inconspicuous fulcral ridge. Also it is seen on a cross section that the joint face has a prominent epiphysis; that is, a calcareous mass present on all the articular surfaces which lies on that of the ossicle itself, from the substance of which it is distinguished by its denser texture. Also it must be admitted that the appearance of the articulation is not essentially different from that of the comparable articulation in *Comanthina schlegelii*.

In discussing the specimen from Jobie, Carpenter said that the characters which he believed to be especially distinctive of the species (*typica*) are the following:

The centrodorsal is stellate, with few or no cirrus sockets, and nearly flush with the radials. The elements of the IBr series are united by syzygy, but the articular line is rarely dotted. The rays may divide seven or eight times. The IIBr series are 4 (3+4), the subsequent division series being 2 (1+2). The first 2 brachials are united by syzygy, and the next syzygy is usually somewhere between brachials 9+10 and 11+12. The distal intersyzygial interval is 3 muscular articulations.

The pinnules decrease in length to about the sixth brachial, and then increase again, though the following pinnules rarely, if ever, reach the length of the lowest pinnules. The segments of the middle and later pinnules are very spiny.

The mouth is usually subcentral and radial, but the ambulacral grooves are unequal. The anus is marginal.

He noted that the specimen from Jobie is an exceedingly fine one, with the disk measuring 20 mm. in diameter and the arms 125 mm. long. It is remarkable for the great length of its lowest pinnules, the first one reaching 16 mm., and also for the great development of spines on the elongated segments of the middle and later pinnules, the edges of which are fringed with strong spines, while a still larger one projects forward and upward on each side near the distal end.

In Müller's type specimen from Eidouma, as redescribed by Carpenter, the centrodorsal is a thin pentagonal disk with its angles slightly produced and about 15 cirrus sockets on its sloping sides.

The cirri are all lost.

Traces of subradial clefts appear between the sides of the centrodorsal and the inner margins of the short radials.

The IBr_1 are shorter than the radials, widely hexagonal and only partly united laterally. The IBr_2 (axillaries) are free, pentagonal, barely two and one-half times as long as the IBr_1, to which they are united by syzygy. The IBr series are quite free laterally. The rays divide four or five times. The IIBr series are 4 (3+4). The succeeding division series are 2 (1+2); the first element is only partially united laterally with its fellow.

The 56 arms are about 90 mm. long. The first 2 brachials form a syzygial pair which is oblong or nearly square. The next 2 brachials are usually articulated, but may form a syzygial pair. The following 2 or 3 brachials are transversely oblong, and their immediate successors are longer, wedge-shaped, with slightly overlapping distal ends. After this both length and breadth diminish and the brachials become blunter and smoother, elongating again toward the arm tips. The arms are dimorphic, those on one side of the calyx (probably the posterior) being shorter with only 60–70 brachials and tapering more rapidly than the longer anterior arms with 80–90 brachials.

The first syzygy is between brachials 1+2, and there is frequently another between brachials 3+4, especially on those undivided arms borne by axillaries which carry division series on their other faces. The next syzygy is usually between brachials 9+10 or 10+11, and the distal intersyzygial interval is 3, or sometimes only 2, muscular articulations.

P_D is moderately long, with a well-marked terminal comb. The next pinnule normally is P_1. The size of this pinnule and also of P_a varies very considerably, being greater on the outer than on the inner arms of each ray. There is a gradual decrease in size from the first pinnule to those on the fourth and fifth brachials beyond, after which they increase again, losing the terminal comb at about the eighth brachial. Their squarish segments have spiny tufts in the mediodorsal line, and at the distal end of each there are one or two rather larger lateral spines. Toward the arm tips the pinnules gradually become more slender, but increase very little in length; their segments become oblong, and the large lateral spines are almost entirely limited to their outer sides.

The disk is missing. Some of the shorter arms have only an imperfect groove and tentacular apparatus, or none at all.

The diameter of the radial ring is 10.5 mm.

The skeleton is grayish white, the perisome a darker gray.

Herklots published a colored plate showing this specimen as it appeared in life. The calyx and division series are orange brown, the undivided arms lighter and rose pink, becoming bright yellow at the extreme tip. The figure gives 40 arms, and shows that the disk was lacking at the time it was drawn. Herklots remarked that Müller in his original description said that the color, as preserved in alcohol, was brown.

In the specimen from north of Port Walcott, Western Australia, there are 5 or 6 successive axillaries on each postradial series, the arms being in the vicinity of 100 in number, and probably about 70 mm. in length. All the IIBr series are 4 (3+4), and all the following division series, with but two or three exceptions, are 2 (1+2), the exceptions being 4 (3+4). The IBr_1 are laterally united, but the IBr axillaries are widely separated. The brachials have slightly prominent and finely spinous distal ends.

The pinnule segments have spinous dorsal surfaces, the outermost 4 or 5 bearing long recurved dorsal spines. Terminal combs occur at intervals on the distal pinnules.

The centrodorsal is rounded pentagonal, discoidal, rising to a height of about 0.5 mm. above the dorsal surface of the radial pentagon, and bearing a marginal row of but partially obliterated cirrus sockets.

The mouth is subcentral.

The color in alcohol is white, with the disk and perisome light brownish.

The type of *Actinometra variabilis* from Thursday Island was thus described by Bell.

The centrodorsal is of moderate size, concave in the middle.

The cirri are X, about 15, marginal in position, about 10 mm. long. There are very faint indications of spines on the most distal segments only.

The radials are visible. The IBr_1 are exceedingly wide in proportion to their length and are in lateral contact. The IBr_2 (axillaries) are almost perfectly triangular. The IIBr series are normally 4 (3+4). The IIIBr series are 2, or 4 (3+4). If there is another division, it is 2.

The 60–90 arms are not very long, and thin. The first 4 or 5 brachials have the sides pretty even and the succeeding are very distinctly wedge-shaped, the distal edge becoming faintly denticulated. Further out the wedge becomes wider and the denticulation disappears.

Syzygies occur between brachials 3+4, 11+12, and 16+17 and distally at intervals of about 4 muscular articulations.

The pinnules generally are delicate and short, the first rather the longest.

The disk is as much as 30 mm. in diameter, owing to the extensive development of the interradial plating, which extends to the IIBr axillaries.

The color is yellowish green, with darker spots, patches, or lines, the ends of the arms and the lower surface darker; or the upper surface may be of a pale flesh color.

The figure shows a specimen with 64 arms. All of the IIBr series are 4 (3+4). All of the following division series are 2 except for 2 IIIBr 4 (3+4) series, both internally developed on the same IIBr series and both paired with an external IIIBr 2 series.

In the specimens in the British Museum collected by the *Alert* at Thursday Island there are 6 postradial axillaries.

The example from Prince of Wales Channel has 64 arms 75 mm. long. There are usually 6 postradial axillaries. The cirri are VII, 15; they are becoming reduced and show signs of disappearing.

The specimen from Port Molle is small and immature, with about 50 arms. The centrodorsal has a row of 12 cirrus sockets which in life probably bore functional cirri. One cirrus stump of 2 segments remains. The lateral interradial portion of the disk is completely plated.

The 2 specimens recorded from Australia (as *multifida*) by Bell resemble that from Port Molle. Both are small. There are 5 or 6 postradial axillaries. The interradial dorsal perisomic areas are heavily plated. There are no cirri, although the cirrus sockets are well formed.

In the small *Challenger* specimen from near Kandavu, Fiji, the arms, according to Carpenter, are shorter and less fleshy than in Lovén's specimens from New Harbour, with less spiny brachials, the terminal faces of which are less closely applied. The basal pinnules are relatively shorter and their component segments less spiny, while the segments of the terminal pinnules are almost smooth and the pinnules stiffer, so that the arms have a less feathery appearance.

On the other hand, a specimen from Fiji obtained from the Godeffroy Museum (presumably the one in the Hamburg Museum) and recorded by Carpenter has moderately feathery arms and more spiny pinnules.

The small specimen from Fiji in the Copenhagen Museum bearing Lütken's manuscript name *stellatus* has nearly 80 arms, which are 80 mm. long. There are 6 or 7 postradial axillaries. Eight of the 10 IIBr series are 2 (1+2), the remaining 2 being 4 (3+4). The distal division series which are developed out of the regular order as described below, 3 in number, are 4 (3+4), the remainder being 2 (1+2). The first syzygy on the undivided arms is between brachials 1+2.

Each IIBr axillary bears externally an undivided arm and internally a IIIBr 2 (1+2) series. The latter bears a IVBr series and an undivided arm, which last is on the opposite side from that arising from the axillary preceding. Subsequent arm divisions are similar, the axillaries bearing each a division series of 2 (1+2) and an undivided arm, the undivided arms being given off from alternate sides. The general appearance, therefore, is that of two very stout arms arising from each IIBr axillary, from which smaller arms arise on every alternate ossicle, being given off first on one side and then on the other.

Of the specimens from Port Galera, Mindoro, one (M. C. Z., 660) is a slender example, with about 130 arms which are about 180 mm. long. Another (M. C. Z., 662) is slender, with about 100 arms which are about 115 mm. long. A third (M. C. Z., 663) is small, with about 100 arms which are about 85 mm. long. Of the remainder (M. C. Z., 618), one has about 150 arms which are about 250 mm. long; one has about 150 arms about 230 mm. long; one has about 100 arms 125 mm. long; two have about 90 arms 125 mm. long; and the last has the arms intertwined dorsally so as to conceal the division series. One specimen (M. C. Z., 661) is represented by fragments.

Carpenter said that some large specimens from Cebu which are preserved in the zoological museums at Dresden and Vienna do not differ much from the type, except that the lower pinnules decrease more gradually in size.

Carpenter noted that in this species the centrodorsal is stellate, with little or no trace of cirrus sockets, and is nearly flush with the radials, sometimes being even below their level. It is separated from the radials by distinct clefts.

He remarked that the articulation between the elements of the IBr series, as illustrated by the *Challenger* specimen from Fiji, appeared to be a syzygy of much the same character as that found in the pentacrinites and in *Rhizocrinus*; that is, with the apposed faces almost smooth and devoid of the radial striation which is so marked in the syzygies of *Antedon*. The result is that the junction line of the 2 ossicles as viewed dorsally is simple instead of being more or less interrupted or dotted, as it is in the case of the syzygies in the later division series. He said that Lovén's figure of the distal face of a IBr_1 seemed to show a median dorsoventral ridge, like that which he figured in the corresponding part of *Heliometra glacialis*. In reality, however, there is not an articular ridge with a fossa on either side of it for the reception of a muscular or ligamentous bundle, but merely a division between the 2 sides of the joint face which has a slight general convexity, and there is a corresponding concavity, which is divided into 2 parts by a median line, on the proximal face of the IBr axillary.

If the 2 ossicles were really articulated, each face would have a median ridge and lateral fossae instead of fitting into one another by a slight curvature. The median line shown by Lovén in his figure of the IBr_1 also appears on an undoubted syzygial face from further out on the ray, and Carpenter had no doubt whatever that the union of the elements of the IBr series is really a syzygial one, although the usual radiating ridges and furrows which are so characteristic of syzygies in comatulids are not present on the apposed faces. Traces of them are sometimes visible, however, as a series of little elevations squarish or oblong in shape which radiate outward from the central canal never, or only very rarely, reaching the margin, and produce the appearance of a syzygial face with its ridges interrupted at intervals. But in other cases the apposed faces are almost smooth. The syzygies further out on the rays, however, are more normal in character.

Carpenter noticed that the pinnules bear terminal combs as far as about the twelfth brachial and that combs occasionally appear further out on the arms.

He described the mouth as being usually subcentral and radial, with the primary ambulacra arranged very much as in *Antedon;* but the anal interradius is considerably the largest, with the anus near its margin and sometimes very difficult to find. The interradial and interpalmar areas are often much plated.

Abnormal specimens.—In this species it is not unusual to find the IIBr series 2 (1+2) instead of 4 (3+4).

In one of the 2 specimens described by Hartlaub from Amboina both of the IIBr series on one of the rays are 2 (1+2).

In the specimen from Jobie, 4 of the IIBr series are 2 (1+2).

In the *Challenger* specimen from near Kandavu, Fiji, there are 4 IIBr 2 (1+2) series, 2 on each of 2 IBr series.

In the specimen from Fiji in the Copenhagen Museum 8 of the IIBr series are 2 (1+2), and only 2 are 4 (3+4).

In the example from Fiji recorded by Carpenter as obtained from the Godeffroy Museum (presumably the one in the Hamburg Museum), which was very likely one of the same lot as the preceding, 4 of the IIBr series are 2 (1+2).

In the specimen from Port Galera, Mindoro, with about 150 arms about 250 mm. long, the IBr_1 is missing on one ray.

Localities.—New Harbour, near Singapore; shallows and muddy places; Capt. Albert Vestöö [Lovén, 1866; P. H. Carpenter, 1881 (as Singapore), 1888 (as Malacca)].

Cape Bantam, western Java [Kuhl and van Hasselt, 1869].

Siboga station 89; Pulu Kaniungan ketjil; 11 meters; coral; June 21, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga; Maumeri, Flores; coral reef; April, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 37; about 40 meters; sand; April 23, 1922 (1).

Ternate, Moluccas [Pfeffer, 1900; A. H. Clark, 1912] (2, H. M.).

Amboina, Moluccas; Dr. J. Brock [Hartlaub, 1891].

Moluccas; Péron and Lesueur, 1803 [Lamarck, 1816; J. Müller, 1841, 1849; P. H. Carpenter, 1879, 1888; A. H. Clark, 1911] (1, P. M.).

Siboga station 231; anchorage at Amboina; 40 meters; coral sand; collected in reef exploration; November 14–18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Island of Jobie, Geelvink Bay, New Guinea; von Rosenberg [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911] (1, L. M.).

Island of Eidouma, New Guinea; Salomon Müller [J. Müller, 1841, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1879, 1881, 1882, 1883, 1884, 1888; Bell, 1882; Hartlaub, 1891; A. H. Clark, 1911, 1912] (1, L. M.).

Blanche Bay, New Britain; Arthur Willey [Bell, 1899] (2, B. M.).

North of Port Walcott, Western Australia (lat. 19° 42′ 06″ S., long. 116° 49′ 48″ E.); 91 meters; *Gazelle* [A. H. Clark, 1909, 1911, 1912, 1913] (1, Berl. M.). Pl. 46, fig. 141.

Alert; Thursday Island; 5.4–7.3 meters; sand [Bell, 1884; A. H. Clark, 1911, 1913] (4, B. M.).

Thursday Island [Döderlein, 1898].

Alert; Albany Island [Bell, 1884].

Alert; Prince of Wales Channel, Torres Strait; 9.1–12.7 meters [Bell, 1884; A. H. Clark, 1911, 1913] (1, B. M.).

Port Molle, Queensland [A. H. Clark, 1911] (1, Austr. M.).

Australia [Bell, 1884; A. H. Clark, 1913] (2, B. M.).

Challenger station 174B, C, or D; near Kandavu, Fiji (lat. about 19° 06′ N., long. about 178° 18′ E.); depth given as 466, 1,115 or 384 meters, none of which can be correct; coral mud; August 3, 1874 [P. H. Carpenter, 1881, 1888; A. H. Clark, 1913] (1, B. M.).

Fiji (Lütken, 1874; P. H. Carpenter, 1881, 1884, 1888; A. H. Clark, 1908, 1909, 1911, 1912] (2, C. M., H. M.). Pl. 46. fig. 140.

Gilbert (or Kingsmill) Islands [P. H. Carpenter, 1888].

Albatross station 5138; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 34.7 meters; sand and coral; February 14, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35053).

Cebu, Philippines [P. H. Carpenter, 1881, 1888].

Port Galera, Mindoro, Philippines; Dr. L. E. Griffin [H. L. Clark, 1921] (9+, M. C. Z., 618, 660–663).

Erroneous localities.—Port Hedland, Western Australia [A. H. Clark, 1911, 1912, 1913]. The specimens referred to are young examples of *Comanthina belli.*

Northwestern Australia [A. H. Clark, 1911]. This refers to *C. belli.*

Percy Islands, north of Port Curtis, Queensland [Bell, 1884; A. H. Clark, 1911]. This refers to *Comanthina schlegelii.*

Australia; Péron and Lesueur, 1803 [A. H. Clark, 1911]. This is an error for Moluccas.

Indian Seas [Dujardin and Hupé, 1862]. This refers to the Moluccas.

Geographical range.—From Singapore and Java to Australia, south to Port Walcott, Western Australia, and Port Molle, Queensland, Fiji, the Gilbert (Kingsmill) Islands, and the Philippines.

Bathymetrical range.—From the shore line down to 91 meters. Most of the specimens have been taken in very shallow water.

History.—Among the various species which were included by Lamarck in 1816 in his new genus *Comatula* was *Comatula multiradiata*, of which he gave a brief description.

In the preparation of his monograph on the comatulids it was necessary for Johannes Müller to know just what the species was to which Lamarck referred. Taking advantage of a visit to the Paris Museum by Franz Herrmann Troschel, he provided the latter with manuscript descriptions of all the species which he knew and asked him to compare with these the specimens which he found.

Troschel took notes on one of the 3 specimens which had served as the basis for Lamarck's short account of *Comatula multiradiata*. The characters indicated by these notes did not agree with those of any described species, and so in 1841 Müller redescribed the specimen as representing a new species which he called *Alecto multifida*.

His description is as follows: The cirri are XX+, 14, with a very small opposing spine. There are 44 arms. There are 3 radials (that is, one radial and the IBr series), of which the third is axillary without a syzygy. The IIBr series are 4 (3+4). From this point on, so long as the arm division continues, every second segment is axillary, but without a syzygy. The brachials have everted ends. The distal intersyzygial interval is 4 muscular articulations. The pinnules are all long. Between the arm bases the dorsal perisome has many plates which unite the arms as far as the second division.

Troschel also visited the Leyden Museum and there made notes on a specimen from New Guinea which had been collected by Salomon Müller. This was described by Johannes Müller in 1841 under the name of *Alecto novae-guineae*, as follows:

The centrodorsal is small. The cirri are XV+. There are 56 arms. The third radial (that is, the IBr_2) is axillary. The IIBr are 4 (3+4). "Between the following axillaries of the arms, which divide four to five times, always only 1 segment. No axillary has a syzygy." This evidently means that the IIIBr and subsequent division series are 2. The distal intersyzygial interval is 3 muscular articulations. The first 2 pinnules are very long, the following pinnules becoming shorter. On each segment of the pinnules there are a few spines. The color is brown. The expanse is 8 inches (216 mm.).

In his monograph published in 1849 Müller referred both of these species to *Comatula*. He repeated without change his original description of *novae-guineae*. In his redescription of *multifida*, which he himself had examined in the meantime, he gave the number of the arms as 40–44 and the number of the cirrus segments as 16 instead of 14. He also mentioned that the last 8 segments of the cirri bore dorsal tubercles. He said that the first pinnules, which are on the second brachials, are the longest.

Dujardin and Hupé, in 1862, under the name of *Comatula novae-guineae* published a translation of Müller's original description (1841). Dujardin, however, personally examined the material in the Paris Museum, and his description of *multifida* differs slightly from that published by Müller. He wrote that the 5 arms almost at the base divide into 8 or 10 pinnulate branches, which seem to arise from the disk in such a way that the number of these branches, ordinarily 44 or 45, may rise as high as 50. The remaining portion of his description is a translation of Müller. The locality given by Dujardin and Hupé is "mer des Indes."

Troschel, in his notes which were incorporated in Müller's original description, recorded the number of arms as 44. Müller, after examining the material in the Paris Museum, gave the arm number as 40–44. Dujardin said that the number of the arms is 44 or 45, and may rise as high as 50.

This discrepancy is easily explained. The specimen studied by Troschel, which is therefore the type of *multifida*, has 45 arms, as I determined from personal examination. Troschel counted only 44, while Dujardin said "44 or 45." The specimen having 40 arms which Müller found together with this individual, was an example of *Capillaster sentosa* taken by Péron and Lesueur in 1803, at the same time and place. The specimen with 50 arms referred to by Dujardin was probably an example of *Comanthus bennetti* with 56 arms, which was also taken by Péron and Lesueur in the Moluccas in 1803. There is in the Paris Museum another specimen of *Capillaster sentosa* with about 50 arms, which was collected in the Moluccas by Quoy and Gaimard, and undoubtedly this also was examined by Dujardin.

A collection of natural-history specimens of different kinds was made by Capt. Albert Vestöö and by him presented to the elementary school at Visby, Sweden. This proved to include several forms of more than usual interest, which, with the consent of Captain Vestöö and of Rector C. Cramérs, were presented to the Riks Museum at Stockholm, through Mr. O. A. Vestöö. Among these were 3 specimens of a remarkably fine comatulid which were considered by Prof. Sven Lovén as representing a new genus. These he described in 1866 under the name of *Phanogenia typica*.

King William I of Holland was deeply interested in science, and under his patronage large collections of natural-history specimens were made in the Dutch overseas possessions. The results of the study of this material were published in sumptuous form. Naturally the more conspicuous and most easily preserved creatures received first attention. But in 1869 there were published under the editorship of Dr. J. A. Herklots a large number of colored figures of echinoderms which were based upon specimens collected and sketches made by Kuhl, van Hasselt, and Salomon Müller. Among these was a figure of a comatulid identified as *Comatula novae-guineae* which had been taken by the last named at Eidouma, an island off the coast of New Guinea. This is the individual which was described in 1841 under the name of *Alecto novaeguineae* by J. Müller.

In 1874 Prof. C. F. Lütken listed *Actinometra stellata* from Fiji in the catalogue of the Godeffroy Museum, but gave no indication of its characters.

Dr. P. H. Carpenter, in 1879, wrote that in *Actinometra multifida*, the type of which he had personally examined in Paris in the autumn of 1876, the tertiary arms borne by the palmar (IIIBr) axillaries may divide again several times. In every case there are only 2 segments between each division, and all the successive axillaries, like the palmar axillaries, have no syzygies. He also observed that the interbrachial perisome contains numerous small calcareous plates.

In the same memoir he wrote that the *Challenger* collection included 2 very abnormal species of *Actinometra*. The rays divide three times, and the first 2 segments (distichals) of each of the 10 primary arms are united by ligaments only, like the second and third radials. The third or axillary distichal bears the secondary arms, which consist of 1 axillary segment only, which is primitively double, being made up of 2 parts united by syzygy. The first joints of each of the ultimate arms borne by this axillary agree with it in being syzygial segments. These species are *Comaster novae-guineae* and *C. distincta*.

In 1881 Carpenter redescribed the type specimen of *Alecto novae-guineae* and described in detail a specimen from Jobie which he identified as *Actinometra typica*, referring it to Lovén's species. As a synonym of the latter he cited the *Actinometra stellata* of Lütken, of which he had examined some duplicates distributed by the Godeffroy Museum. He mentioned that during his visit to Copenhagen he found that Lütken had already come to the conclusion that his *stellata* was the same as Lovén's *typica*. He discussed the proximal syzygies in this species at considerable length and gave a summary of its distinctive characters. He said that no 2 specimens of this type which he had seen are quite alike, but they pass into one another so very gradually that it is practically impossible to separate them. He mentioned some large specimens from Cebu in the zoological museums at Dresden and at Vienna, and one dredged near Fiji by the *Challenger*.

He considered *typica* as the nearest ally of *novae-guineae*, but differing in the stellate centrodorsal with few or no cirrus sockets, and in the much longer and more slender segments of the terminal pinnules, which have the large lateral spines occurring on both sides instead of being almost entirely limited to the outer side of each segment.

Prof. F. Jeffrey Bell in 1884 recorded a number of specimens of this species which had been collected by the *Alert* in the Torres Straits region under the name of *Actinometra multifida*. He also described as a new species *Actinometra variabilis* based on 4 specimens from Thursday Island which do not differ in any way from others which he referred to *multifida*. Under the name *multifida* he included a specimen of *Comanthina schlegelii* from the Percy Islands.

In 1884 Carpenter mentioned the occurrence of syzygies between the elements of the IBr series in *novae-guineae* and *typica*, and the anomalous development of this syzygy in *typica*. He also noted the extreme reduction of the centrodorsal in *stellata*. He divided the species of "*Actinometra*" into 8 groups, one of which he called the "Group of *Actinometra typica*."

In 1888 Carpenter redescribed *Actinometra typica* on the basis of the single specimen secured by the *Challenger*. His description differed only slightly from that which he had published in 1881. The only additional features he mentioned were that the lowest pinnules have a well-defined terminal comb which extends out to about the twelfth brachial and occasionally appears further out on the arms, and that both the "interradial and interpalmar areas are often much plated." He discussed the peculiarities of this type in great detail, but without bringing out any new facts other than that the specimen of *Actinometra stellata* (which he regarded as a synonym of *typica*) in the Copenhagen Museum has 8 out of the 10 IIBr series of 2 elements only which he believed to be united by synarthry and not by syzygy.

He discussed the characters of *novae-guineae* at some length, and referred this form to the *Typica* group. In the key to the species of this group he differentiated it from *typica* by the possession of functional cirri and from *multibrachiata* by the possession of 3 or 4 instead of 6 or 8 "postradial" axillaries, as well as by the possession of "few" instead of "well-developed" cirri.

The arm structure of Bell's *variabilis* he treated in some detail. He placed this form in the *Parvicirra* group including "tridistichate species with a pinnule on the second brachial and a syzygy in the third." In the key to the species of the *Parvicirra* group he placed it next to *multifida*, from which it was distinguished by the possession of XX instead of X cirri. But in his original description of *multifida* Müller gave the number of the cirri as XX, so that this difference does not hold.

Dr. Clemens Hartlaub in 1891 recorded 2 specimens of *Actinometra typica* from Amboina and described them in detail. He also discussed at considerable length the articulation between the elements of the IBr series in the *Typica* group which Carpenter assumed to be a syzygy, reaching the conclusion that it does not differ essentially from that found in such species as some of those which Carpenter assigned to the *Parvicirra* group.

Prof. Ludwig Döderlein in 1898 recorded *Actinometra belli* from Thursday Island; but one of his figures supposedly of that form represents this species. In the succeeding year Prof. F. Jeffrey Bell recorded this species, as *Actinometra typica*, from Blanche Bay, New Britain, where it had been collected by Prof. Arthur Willey. One of his three specimens, however, is referable to *C. gracilis*.

In 1908 I renamed *Actinometra multifida* of P. H. Carpenter, which I erroneously assumed to be different from the *Alecto multifida* of Müller, *Comaster carpenteri*. The reasoning was that *Alecto multifida* of Müller, according to the author's own statement, is a synonym of *Comatula multiradiata* Lamarck. Müller took the ground that Lamarck's description was not indentifiable, but that the same name had been applied by Goldfuss to quite a different species which was adequately described, so that the name *multiradiata* held for the latter. He therefore proposed *multifida* to cover Lamarck's type specimens. This is all correct; but I went on to say that we know now what the *Comatula multiradiata* of Lamarck really is, and that it is the same as one of the species included in the Linnean *Asterias multiradiata*. Therefore it is really the *Comatula multiradiata* of Goldfuss that needs a new name, and *Alecto multifida* of Müller becomes a pure synonym of *Comatula multiradiata* Lamarck, which itself is a synonym of *Asterias multiradiata* Linné.

In another paper published in 1908 I recorded under the name of *Phanogenia typica* two specimens which had been dredged by the *Albatross* in the Philippines, and discussed at some length the characters of the division series in this and allied species. The numerous specimens recorded here as *Phanogenia novae-guineae* represent in reality *Comaster fruticosus.*

In 1909 in a discussion of the new species *Comanthus* [*Comantheria*] *polycnemis* I stated that Bell's *variabilis* and the *multifida* of Müller and of Carpenter do not belong in the *Parvicirra* group where they were placed by Carpenter, but instead are nearly related to *Phanogenia typica.* In another paper I recorded, and gave extended notes upon, a specimen which had been dredged by the German steamer *Gazelle* north of Port Walcott, and in a third paper I recorded and described a specimen from Fiji in the Copenhagen Museum which bore the manuscript name *Actinometra stellata* of Lütken, and which had previously been studied by Carpenter. The example recorded under the name of *Comaster novae-guineae* in this last paper is the type specimen of *C. schönovi.*

Having discovered my error in regard to *multifida,* I published a correction of it in 1909. By describing *Alecto multifida,* Müller had in effect fixed the identity of Lamarck's *Comatula multiradiata,* which is not identical with the Linnean *Asterias multiradiata.* Carpenter's *multifida* is the same as Müller's *multifida.* I remarked that *Alecto multifida* is a somewhat anomalous species congeneric with, though not closely related to, *Phanogenia typica* of Lovén. This incorrect statement was due to my having at hand a specimen from the Philippines which I had determined as *multifida,* but which I later found to be a wholly different type and described under the name of *Comaster taviana.*

In 1910 I examined the type specimen of *multifida* in the Paris Museum and Bell's material in the British Museum. In 1911 in a paper on the recent crinoids in the Paris Museum I published a detailed account of Müller's type and remarked that it is the same as the *Actinometra variabilis* of Bell and a derivative from *Comaster typica,* which is found only in the waters of northern Australia.

In a paper on the recent crinoids of the Leyden Museum, published in the same year, I gave notes upon the specimen from Jobie recorded as *Actinometra typica* by Carpenter, and upon the type of Müller's *Alecto novae-guineae.* The specimens of *novae-guineae* of a rough and spinous character which are mentioned in this paper are in reality *C. fruticosus.*

In a monograph on the crinoids of Australia, also published in 1911, I described a specimen of *C. typica* from Port Molle, listed all the known Australian records, and gave an annotated synonymy and a summary of the range. *Comaster multifida* was treated separately as "a curious local derivative from the comparatively widely spread *C. typica* type."

In a memoir on the crinoids of southwestern Australia published in 1911 I gave a summary of the occurrence of *Comaster typica* on the Australian coasts, with a complete list of localities. The 3 specimens recorded and described, however, represent *C. belli* and not *C. typica.*

In another paper published in 1911 I discussed the relationships of *typica* and *multifida* and noted that Bell's *variabilis* was based upon specimens of both, the type being a specimen of *typica.* I mentioned that a specimen of *Comaster multifida* which I had recorded from the *Albatross* Philippine collections fitted the available descriptions of *multifida* exactly, but that when I examined the type of the latter in Paris

I found it to be quite a different thing from what I had supposed. I therefore described the *Albatross* specimen as representing a new species which I called *Comaster taviana.*

In a memoir on the crinoids of the Indian Ocean published in 1912 *Comaster typica* and *C. multifida* were considered as distinct, and the synonymy and range of each were given. All previous records of these forms were cited.

In a paper on the crinoids of the Museum für Naturkunde in Berlin published in 1912 there were mentioned under the name of *C. typica* the specimen from north of Port Walcott and also the 5 from southwestern Australia which really represent *C. belli.* In another paper on the crinoids in the Hamburg Museum, published also in 1912, the specimen from Fiji was listed as *C. typica,* and 2 from Ternate, previously recorded by Pfeffer, were mentioned under the name of *C. novae-guineae.*

In 1913, in a supplement to my memoir on the crinoids of southwestern Australia (1911), I redetermined as *Comaster belli* the 3 young specimens from Port Hedland which I had previously described under the name of *C. typica.* In a paper on the crinoids of the British Museum published in the same year I reidentified and listed all of the specimens in that institution, and in 1915 I discussed at considerable length the distribution of this form on the Australian coasts.

In 1918 I recorded and gave notes upon 3 specimens which had been collected by the *Siboga* in the Dutch East Indies, and also gave a synonymy of the species. A key to the species of the genus *Comaster* was included in this work, and in this *typica* and *multifida* were considered as distinct forms.

In 1921 Dr. Hubert Lyman Clark discussed this species in great detail in reference to its relation to the echinoderm fauna of Australia.

COMASTER GRACILIS (Hartlaub)

Plate 47, Figures 143, 144

Actinometra gracilis Hartlaub, Nachr. Ges. Göttingen, May 1890, pp. 170, 187 (description; Pulo Edam); Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 11 (collected by Brock); p. 111 (Pulo Edam, near Batavia; detailed description and comparisons); p. 113 (in Göttingen Mus.); pl. 5, fig. 55.—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 684 (assigned by Hartlaub to the *Typica* group); Crinoids of the Indian Ocean, 1912, p. 38 (identity).

Actinometra, sp. Bell, Proc. Zool. Soc. London, 1894, p. 402 (notes on a specimen); Crinoids of the Indian Ocean, 1912, p. 287 (=*C. gracilis*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 79 (same).

Actinometra typica Bell, Willey's Zool. Results, part 2, 1899, p. 134 (Blanche Bay, New Britian).

Antedon indica (part) Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 224 (Hulule, Maldives).

Comaster gracilis A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 139 (synonymy; Singapore; description of specimens); p. 193 (collected at Singapore by Svend Gad); Crinoids of the Indian Ocean, 1912, pp. 38, 39, 40 (identity of previous records); p. 84 (synonymy; Port Blair, Andamans; summary of previous records); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 12 (published references to specimens in the B. M.; localities represented); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 35 (in key; range).

Phanogenia gracilis A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203 (arm structure); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 392 (arms compared with those of *C. minima*).

Actinometra tridistichata (B. M., MS.) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 84 (Bell, MS. =*Comaster gracilis;* Macclesfield Bank, 30 fathoms); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 79 (same).

Actinometra stellata (B. M., MS.) A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (Fiji).

Diagnostic features.—In general resembling *multifida* but smaller and of a much more slender build, the division series being narrow and widely separated. The arms average 56 in number. The division series and arms have a conspicuous dark narrow mediodorsal stripe. The centrodorsal is greatly reduced and stellate.

Description of the type specimen.—The centrodorsal is small and flat with a central concavity, pentagonal with slightly concave sides, scarcely raised above the dorsal surface of the radials.

The entire dorsal surface of the radials is visible. The IBr_1 are oblong, about 3 times as broad as long, and entirely free laterally. The IBr_2 (axillaries) are broadly pentagonal, with the lateral borders almost or quite as long as those of the IBr_1 and making with them a straight line or a slight angle; the anterior sides are slightly concave and the anterior angle is broader than a right angle with a rounded apex. The IIBr series are 4 (3+4) and the following series are all 2 (1+2). The division series are narrow and widely separated, and the arms divide not more than four times.

The arms are 48 in number, about 160 mm. long, very slender, and becoming extraordinarily attenuated in the distal portion. The brachials are moderately long. The first and second brachials are oblong, broader than long, and are united by syzygy. The next 3 or 4 are similar, and the remainder are short wedge-shaped, with somewhat projecting distal edges which are armed with fine spines.

Syzygies occur between brachials 1+2, 10+11, or 11+12, and thence at intervals of 3 muscular articulations.

The disk is 15 mm. in diameter, somewhat incised, and beset with fine calcareous concretions. The mouth is almost central.

P_D is about 13 mm. long and is composed of numerous segments, of which the distal are somewhat longer than broad; the comb is quite inconspicuously developed and is rolled into a small knob. P_1 is shorter, and the 3 following pinnules are much shorter. The succeeding pinnules gradually increase in length, reaching 10 mm. distally. The lower pinnules are slender. The segments of the distal pinnules are very spiny.

The color in alcohol is light grayish brown, the division series and arms with 3 longitudinal lines of dark brown, 1 mediodorsal and the other 2 dorsolateral; the last are only slightly evident on the arms. On the arms light-grayish-brown and dark-brown patches alternate. The disk is dark brown.

Notes.—In the specimen from the Maldives there are a few VBr series.

The specimen from the Andamans is small and resembles those from Singapore in the Copenhagen Museum, with which it was compared directly.

One of the specimens from Singapore may be described as follows: The centrodorsal is minute and sharply stellate. The radials are trapezoidal, distally about twice as broad as their length. The IBr_1 are short, oblong, four or five times as broad as long, in apposition in their basal half but free distally. The IBr_2 (axillaries) are almost triangular, twice as broad as long. The $IIBr_2$ series are 4 (3+4). The IIIBr and following division series are 2 (1+2). Beginning on the IIBr axillaries, the successive division series form 2 diverging arm trunks, from which on every other ossicle arms are given off on alternate sides, the first being always external; the arm trunks terminate in a pair of similar arms. There are 4 or 5 (usually 4) postradial axillaries.

The 58 arms are 125 mm. long. The first 2 brachials are small and wedge-shaped, the next 3 are oblong, half again as broad as long, and those following become triangular and about as long as broad, toward the middle of the arm wedge-shaped and about as long as broad, and in the terminal portion wedge-shaped and longer than broad. The elements of the division series, and especially the brachials, have everted and finely spinous distal ends, which give the animal a characteristic rough feeling and appearance.

P_D is very slender, 15 mm. in length, with a peculiar abrupt comb at its distal end which is composed of 13 large and long curved teeth. The proximal brachial pinnules are exceedingly slender and hairlike. P_1 is from 10 to 12 mm. long. P_2 is 8 mm. long. P_3 is 5 mm. long. All of these pinnules bear combs similar to that on P_D. The following pinnules are stouter, after P_5 without terminal combs and about 7 mm. long, distally becoming more slender and increasing in length to 10 mm. The distal pinnules are composed of elongated segments with swollen articulations; the end of each segment is armed with long coarse spines, and the surface is thickly covered with shorter spines. The terminal 3 or 4 segments bear several long recurved spines dorsally. Perfectly formed terminal combs appear at intervals on the distal pinnules.

The other specimen from Singapore is smaller. It has about 80 arms. Eight of the IIBr series are 2, and only 2 are 4 (3+4). In other respects this specimen resembles the preceding.

In one of the specimens from Lontor, Banda, there are 64 arms 170 mm. long. All of the IIBr series are 4 (3+4). The division series and arms are very slender. The centrodorsal is exceedingly small and is sharply stellate.

A similar specimen from Lontor has 72 arms 170 mm. long. Of the 10 IIBr series 6 are 4 (3+4) and 4 are 2. The centrodorsal is exceedingly small and sharply stellate.

The third specimen from Lontor has 52 arms 170 mm. long. Of the 10 IIBr series 6 are 4 (3+4) and 4 are 2. The centrodorsal is extremely small and sharply stellate. The radials are twice as broad distally as their median length. As in the other 2 the division series are very narrow and the arms are exceedingly slender.

One of the specimens from Soutre, Banda, has 71 arms 150 mm. long. The centrodorsal is greatly reduced and is very sharply stellate. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. The succeeding division series are all 2, except for a single IIIBr series, which is 3. The IIIBr axillaries carry a IVBr series interiorly and an undivided arm exteriorly. The IVBr axillaries bear a VBr series on the side opposite that from which the IVBr series arises on the IIIBr axillary and an undivided arm on the other face. The division series are narrow and widely separated and the arms are very slender. The brachials have somewhat produced distal edges armed with numerous fine spines.

Another specimen from Soutre has 59 arms 135 mm. in length. The 10 IIBr series are 4 (3+4), and all the subsequent series are 2.

A third specimen from Soutre has 58 arms 145 mm. long. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. The following division series are all 2. The radials are about twice as broad as their median length. The division series are narrow and widely separated and the arms are very slender. The centrodorsal is very small and is sharply stellate.

A fourth specimen from Soutre has 52 arms 170 mm. long. Of the 10 IIBr series, 7 are 2, 1 is 4 (3+4), 1 is 3, and 1 is 3 (1+2+3). The following division series are 2 except for one IIIBr series, which consists of a single axillary ossicle. The centrodorsal is extremely small, its diameter being less than the length of the radials. The radials are triangular, with their inner apices slightly truncated.

The fifth specimen from Soutre has 41 arms 150 mm. long. The 10 IIBr series are 4 (3+4). Of the 20 IIIBr series, 18 are 2 and 2 are 4 (3+4). There is a single IVBr 4 (3+4) series next to the midradial line. The division series are narrow and widely separated and the arms are very slender. The centrodorsal is greatly reduced and stellate, the dorsal surface not rising above that of the radial pentagon.

In the specimen from New Britain there are 3 or 4 postradial axillaries.

The example from Suva, Fiji, has about 40 arms.

Localities.—Hulule, Maldives; Prof. J. Stanley Gardiner [Bell, 1902; A. H. Clark, 1913] (1, B. M.).

Port Blair, Andaman Islands [A. H. Clark, 1912] (1, I. M.).

Singapore; Svend Gad [A. H. Clark, 1909] (2. C. M.).

Pulo Edam, near Batavia, Java [Hartlaub, 1890, 1891].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Banda; Lontor; 25 meters; stones; June 11, 1922 (3); Soutre; 25 meters; coral and sand; July 11, 1922 (5). Pl. 47, figs. 143, 144.

Macclesfield Bank; 55 meters [Bell, 1894; A. H. Clark, 1913].

Blanche Bay, New Britain; Prof. Arthur Willey [Bell, 1899; A. H. Clark, 1913] (1, B. M.).

Suva, Viti Levu, Fiji (1, M. C. Z., 759).

Fiji [A. H. Clark, 1913] (1, B. M.).

"Section A. Ship"; 13 meters [A. H. Clark, 1913] (arms, B. M.).

Geographical range.—From the Maldive Islands eastward to New Britain, Fiji, and the Macclesfield Bank.

Bathymetrical range.—Littoral and sublittoral; the only depth records are 13 and 55 meters.

Remarks.—Hartlaub sent the type specimen of this species to Dr. P. H. Carpenter, who said that he was unable to identify it with *C. multifida*. The grounds upon which Carpenter and Hartlaub considered it distinct from *C. multifida* are the following: It is of much smaller size and of markedly more slender build. The division series are much more slender, and the arms also are markedly more slender. The division series are more widely separated, and the IBr_1, which in *C. multifida* are united, are in *C. gracilis* laterally free. In *C. multifida* the postradial series divide up to seven times, while in *C. gracilis* they do not divide more than four times, and in the type specimen there are only very few IVBr series. The centrodorsal also shows noteworthy differences. In *C. gracilis* it is less stellate, is not separated from the radials by subradial clefts, and is slightly raised above the surface of the radial ring. It bears a rounded prominence in the center.

But the general agreement between this form and *C. multifida* is so close that Hartlaub believed himself justified in considering it merely as a variety of *C. multifida*.

An examination of the notes given herewith on specimens determined as *C. multifida* and as *C. gracilis* shows that in no single feature is there a sharp dividing line between the two. Nevertheless, in most cases they are very easily distinguishable.

It can therefore scarcely be doubted that these two forms are representatives of the same specific type. What their true relation is must be left for future determination.

History.—This form was first described by Dr. Clemens Hartlaub in 1890, and was described in greater detail and figured in the following year.

In a paper on a collection of comatulids from the Macclesfield Bank published in 1894 Bell wrote, under the heading *Actinometra*, sp.:

> Mention must also be made of an *Actinometra* to which I think it would be wrong to give a specific name, so broken is it, but of which it would be more wrong not to say something. It will be remembered that the late Dr. H. Carpenter divided the tridistichate species of this genus into those in which there is a syzygy on the second brachial, and into those that have it on the third. In the specimen now before me there is no sign of any syzygy on either the second or the third brachial.

I found this specimen in the British Museum bearing the manuscript name *Actinometra tridistichata*, and ascertained that it is an example of the present form.

While 2 of the specimens collected by Prof. Arthur Willey at New Britain and recorded by Bell in 1899 as *Actinometra typica* are referable to *Comaster multifida* (of which *typica* is a synonym), the third is a representative of this form.

The *Antedon indica* recorded by Bell in 1902 as having been collected by Prof. J. Stanley Gardiner in the Maldives proved on examination to be this species.

In 1909 I recorded and gave notes upon 2 specimens which had been collected at Singapore by the Danish consul at that port, Mr. Svend Gad.

In 1912 I recorded a specimen from the Andamans which had been collected by the naturalists of the Royal Indian Marine Survey steamer *Investigator*, at the same time giving an annotated synonymy of this species and a summary of the known records. In the list of localities Pulo Edam is said to be in the China Sea, whereas in reality it is near Batavia, Java; the Philippine Islands and Cebu are included among the localities inadvertently through confusion with *C. multifida* (*C. typica* as there given).

In 1913 I listed and gave notes upon all of the specimens of this species in the British Museum, and in another paper listed this form as among the comatulids occurring on the coast of China. This was an error, due to my having placed Pulo Edam in the China Sea.

In my report upon the comatulids collected by the *Siboga* in the Dutch East Indies, this form was included in the key to the species of the genus *Comaster* and the range was erroneously given as "Pulo Edam, China Sea, to Singapore."

COMASTER MINIMA A. H. Clark

Plate 52, Figures 155, 156

[See also vol. 1, pt. 2, fig. 187 (dorsal view), p. 106]

Phanogenia minima A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 392 (description; *Albatross* station 5108).

Comaster minima A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 89 (synonymy; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 35 (in key; range); p. 38 (references; notes; stations 37, 302); pp. 271, 276 (listed); pl. 16, fig. 23.

Comaster minimus H. L. Clark, Records Australian Mus., vol. 15, No. 2, Nov. 18, 1926, p. 184 (off Ellison reef; 5–15 fathoms).

Diagnostic features.—Very small and exceedingly delicate, with extremely narrow division series and excessively attenuated arms and pinnules. The arms average 20 in number. The centrodorsal is greatly reduced and stellate.

Description.—The centrodorsal is small and stellate.

There are no cirri.

The radials are entirely visible, trapezoidal, proximally twice and distally three times (or rather more) as broad as long. The IBr_1 are four times as broad as long, decreasing slightly in width distally, and entirely free laterally. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long. The IIBr series are 4 (3+4), rarely 2; the IIIBr series are 2 (1+2); the IVBr series are 2 (1+2), but are rarely present.

The arms are about 40 in number, 70 mm. long. The brachials and pinnules resemble those of *C. gracilis*, but are proportionately more slender and delicate.

The color in alcohol is dull yellowish with numerous longitudinal narrow lines on the radials and division series, and transverse lines on the arms, of dark brown.

Notes.—One of the specimens from *Siboga* station 37 has 16 arms about 40 mm. long. There are 2 IIBr 4 (3+4) series, each of them bearing 2 IIIBr 2 series. The centrodorsal is a very thin pentagonal disk without cirri, but with obsolete cirrus sockets.

I am rather doubtful about the correctness of the determination of this example. Though agreeing well with the type of *C. minima*, it does not show the extreme delicacy of build characteristic of that form, and it is possible that it is only a very young individual of *C. multifida*.

The other specimen from *Siboga* station 37 is very small; it has 10 arms 20 mm. long. The centrodorsal is much reduced and bears V cirri which have 8, 9, 10, 12, and 12 segments.

The specimen from the Danish expedition to the Kei Islands station 90 is very small, with 3+3, 3+3, 1+7, 6+7, 1+5=39 arms, which are 60 mm. long. Of the 7 IIBr series, 5 are 4 (3+4) and 2 are 2.

The specimen from Tajando Island, which appears to be of this species, has 10 arms about 50 mm. long.

The individual from *Siboga* station 302 has 19 arms about 90 mm. long. Three of the IBr series bear a single IIBr 4 (3+4) series, and each of the latter bears 2 IIIBr 2 series. The arms are excessively delicate and attenuated and greatly elongated, and the pinnules are exceedingly slender and hairlike. The distal ends of the brachials and pinnulars, especially the latter, are exceedingly spinous. The distal pinnules are 9 mm. long. The dorsal interradial perisome is heavily plated, and this plating is continued on to the ventral surface of the disk in the form of deep crescents which extend inward in the interambulacral areas. The plates of the inner portion of these crescents are thickly studded with long sharp spines. The anal tube is completely plated, the plates bearing numerous long spines. The mouth is central and the anal tube subcentral.

As described by Dr. H. L. Clark, the specimen from off Ellison Reef has 21 arms which are from 75 to 80 mm. long, and no cirri. Four IIIBr 2 series are present, 2 of these being on a single postradial series. The color is light brown. Doctor Clark remarked that the whole appearance of this specimen is much more delicate than that of *Comatella*, *Comatula*, or *Comanthus*.

Localities.—*Siboga* station 37; Sailus ketjil, Paternoster Islands, north of Sumbava, Lesser Sunda Islands; 27 meters and less; close to the reef; coral and coral sand; March 30–31, 1899 [A. H. Clark, 1918] (2, U.S.N.M., E. 477; Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 90; Sebesi Strait, between Sumatra and Java; 36 meters; hard bottom; August 1, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; eastern side of Tajando Island; 11 meters; coral; April 6, 1922 (1).

Siboga station 302; off the southwestern end of Timor (lat. 10° 27′ 54″ S., long. 123° 28′ 42″ E.); 216 meters; sand and coral sand; February 2, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.). Pl. 52, fig. 156.

Off Ellison Reef, outer Great Barrier Reef, Queensland; 9–27 meters; August, 1924 [H. L. Clark, 1926].

Albatross station 5108; China Sea, off southern Luzon, Philippines; Corregidor Light bearing N. 39° E., 22.5 miles distant (lat. 14° 05′ 05″ N., long. 120° 19′ 45″ E.); 24 meters; bottom temperature 26.67° C.; coral bottom; January 15, 1908 [A. H. Clark, 1909, 1918] (1 U.S.N.M., 25469). Pl. 52, fig. 155.

Geographical range.—From the Sunda Islands and northern Australia to the Philippines.

Bathymetrical range.—Sublittoral; from 24 (?9) to 216 meters.

Thermal range.—One record, 26.67° C.

COMASTER MULTIBRACHIATA (P. H. Carpenter)

Plate 46, Figure 142

[See also vol. 1, pt. 1, fig. 59 (comb), p. 85; pt. 2, figs. 414–417 (pinnule tips), p. 255; fig. 696 (disk), p. 341; pl. 11, fig. 1029 (analysis of arm structure); pl. 17, fig. 1073 (oral pinnule)]

Comatula, sp. P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, p. 23, footnote (first 2 distichals united by syzygy).

Actinometra novae-guineae P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 386.

Actinometra multibrachiata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 299 (description; Banda; remarks); pl. 56, figs. 3, 4.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 109 (systematic position).—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol 1, Heft 1, pp. 217 and following (regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 684 (assigned by Carpenter to the *Typica* group); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 748 (same); Crinoids of the Indian Ocean, 1912, p. 35 (identity).

Actinometra regalis Bell, Proc. Zool. Soc. London, 1894, p. 396 (Macclesfield Bank, 30 fathoms).

Comatula multibrachiata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (listed); vol. 35, 1908, p. 124 (listed).

Phanogenia multibrachiata A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203 (arm structure; systematic position); p. 204 (*Albatross* stations 5141, 5142, 5146); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 392 (*Albatross* stations 5248, 5249, 5254).

Comaster multibrachiata A. H. Clark, Crinoids of the Indian Ocean, 1912, pp. 35, 38 (identity of previous records); p. 86 (Andaman Is.; description; summary of previous records); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (published reference to the specimen in the B. M.; Banda, 17 fathoms.); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 35 (in key; range); p. 39 (references; stations 240, 316); pp. 274, 276 (listed).

Comaster fruticosus A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, p. 13 (published reference to a specimen in the B. M.; Macclesfield Bank, 30 fathoms; characters).

Diagnostic features.—Large and robust, with 140–160 arms and numerous stout cirri consisting of 13–16 segments. All the preserved specimens which I have seen are dark red or yellow brown in color.

Description.—The centrodorsal is discoidal, rather thick, circular to subpentagonal, with the sides sloping inward toward the broad and deeply concave dorsal pole. It is separated from the radials by large and deep subradial clefts, which cause the sides to appear to project somewhat over the radials. The cirrus sockets are arranged in from 1 to 2 irregular and alternating marginal rows.

The cirri are numerous, large and stout, but usually showing much diversity of development in each individual, about XXV, 14–16. Nearly all of the segments are longer than broad. The opposing spine is small.

The radials are short, five or six times as broad as long, with the distal border straight and the dorsal surface in the proximal portion more or less concave, forming an arched ventral wall to the subradial cleft beneath. The IBr$_1$ are short, from four to six times as broad as long, with the proximal and distal edges straight and parallel and the lateral edges parallel and usually in more or less extensive contact basally. The IBr$_2$ (axillaries) are short, about 3 times as broad as long, triangular, with the lateral angles broadly truncated and widely separated from those of their neighbors, and the distal angle obtuse. The 2 elements of the IBr series are united by a more or less perfect syzygy. The IIBr series are 4 (1+2, 3+4), the syzygy between the first 2 elements being more or less perfectly developed. They are rather narrow, well rounded dorsally, and widely separated. The following division series are, with some exceptions, 2 (1+2); VIIBr series are often and VIIIBr series sometimes present. The IIBr axillaries each bear 2 IIIBr 2 (1+2) series. The IIIBr and all following axillaries bear typically a further division series on one face and an undivided arm on the other, the relative position of the two derivatives alternating on successive axillaries, so that at first sight it appears as if each IIBr axillary gave rise to 2 stout arm trunks giving off on every other ossicle branches on alternate sides, the first being always external, and finally ending in a pair of arms. Division series developed where typically there would be an undivided arm—that is, on an axillary face adjacent to one carrying a IVBr or later division series—are almost always 4 (3+4).

One of the posterior radials, together with the postradial series which it bears, is often smaller than the others, and may be scarcely half as large, as in the case of the type specimen.

The arms in the type are about 150 in number and about 150 mm. in length. They are composed of about 150 brachials, most of which are short, very obliquely wedge-shaped, with produced and very spinous distal ends.

Syzygies occur between brachials 1+2, sometimes also between brachials 3+4, again from between brachials 11+12 to between brachials 13+14, and distally at intervals of 3 or 4 muscular articulations.

P_D is very long and slender, and is composed of very numerous short segments. P_1 is similar but much smaller, and the next few are of decreasing length, after which there is but little increase. The lowest pinnules have a well-defined comb which extends to about the twelfth brachial and reappears on more or fewer of the distal pinnules. The segments of the middle and later pinnules are very spiny.

The color in alcohol is dark brown.

The preceding description is adapted, with but little change, from Carpenter's original account of the type specimen.

Notes.—The specimen from the Andaman Islands is rather small, with about 160 arms which are 90 mm. long. It agrees with others from the Philippine Islands.

The specimen from *Siboga* station 316 is typical. There are between 140 and 150 arms. One of the IBr series is 6 (5+6). The cirri are XVI, 14–15.

The *Challenger* specimen from Banda is exactly like the large specimens from the Philippines.

The specimen from *Siboga* station 240 (Banda) is small and very badly broken.

The example from the Macclesfield Bank has about 150 arms. The cirri are XVII, 13–15.

Abnormal specimen.—The example from *Siboga* station 316 has one of the IBr series 6 (5+6).

Localities.—Investigator; Andaman Islands [A. H. Clark, 1912] (1, U.S.N.M., 35967). Pl. 46, fig. 142.

Siboga station 316; near the Paternoster Islands, north of Sumbava (lat. 7° 19′ 24″ S., long. 116° 49′ 30″ E.); 538 meters; fine dark-brown sandy mud; February 19, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger; Banda; 31 meters [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Siboga station 240; anchorage at Banda; 9–45 meters; black sand; coral; lithothamnion bank; November 22 to December 1, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Albatross station 5146; in the vicinity of Siasi, Jolo (Sulu) archipelago; Sulade Island (E.) bearing N. 18° W., 3.4 miles distant (lat. 5° 46′ 40″ N., long. 120° 48′ 50″ E.); 44 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35049).

Albatross station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908] (2. U.S.N.M., 36133).

Albatross station 5141; in the vicinity of Jolo; Jolo Light bearing S. 17° E., 5.5 miles distant (lat. 6° 09′ 00″ N., long. 120° 58′ 00″ E.); 53 meters; coral sand; February 15, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35041).

Albatross station 5254; Gulf of Davao; Linao Point bearing N. 44° E., 0.7 miles distant (lat. 7° 05′ 42″ N., long, 125° 39′ 42″ E.); 38 meters; sand and coral; May 18, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 34958, 35042).

Albatross station 5249; Gulf of Davao; Lanang Point bearing N., 1 mile distant (lat. 7° 06′ 06″ N., long. 125° 40′ 08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 34960, 34962).

Albatross station 5248; Gulf of Davao; Lanang Point bearing S. 33° W., 0.4 mile distant (lat. 7° 07′ 25″ N., long. 125° 40′ 24″ T.); 33 meters; coral bottom; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34973).

Macclesfield Bank; 55 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Geographical range.—From the Andaman and the Lesser Sunda Islands to the Philippines.

Bathymetrical range.—From 31 (?9) to 55 (?538) meters; the average of 9 records (omitting that from the Andaman Islands, where no depth is given, and *Siboga* station 316, where the depth would seem to be beyond the probable limit) is 43 meters.

History.—This species was first mentioned by Carpenter in 1879 as one of three comatulids having an anomalous arm structure. He said that in this (the third species, the others being forms of *Comatula rotalaria*) the rays may divide eight times, and in the primary divisions there are 3 distichal joints, the first 2 of which are united by ligaments and not by syzygy. But in all the subsequent divisions the first 2 joints beyond each axillary form a syzygy, like the second and third radials.

The species was first described by Carpenter in 1888 from a single broken specimen secured by the *Challenger* at Banda. A specimen from the Macclesfield Bank was recorded as *Actinometra regalis* by Bell in 1894.

In 1908 I recorded it from three *Albatross* stations in the Philippines, and in 1909 from three more. In 1913 I published some notes on the type specimen in the British Museum, and at the same time redetermined Bell's specimen from the Macclesfield Bank (erroneously) as *C. fruticosus.* In 1918 I recorded *C. multibrachiata* from two of the *Siboga* stations in the Dutch East Indies.

COMASTER FRUTICOSUS A. H. Clark

Plate 48, Figure 145; Plate 49, Figures 146, 147

[See also vol. 1, pt. 1, figs. 37, 40 (syzygies), p. 75; fig. 246 (ventral view of centrodorsal), p. 251; fig. 459 (dorsal view of radial pentagon), p. 357; pt. 2, figs. 21, 22 (centrodorsal and radials), p. 15.]

Phanogenia novae-guineae A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 204 (*Albatross* stations 5136, 5137, 5138, 5142, 5147, 5153, 5174, 5179; characters of the specimens).

Comaster novae-guineae A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 173 (articulation between the elements of the IBr series a pseudosyzygy); Notes from the Leyden Mus., vol. 33, 1911, p. 178 (the rough and spinous specimens from the Philippines).

Comaster fruticosus A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 532 (description; *Albatross* station 5356); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 21 (compared with *Comaster sibogae*); Crinoids of the Indian Ocean, 1912, p. 84 (synonymy; range); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (in part; Malayan species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 36 (in key; range); p. 36, footnote 2 (includes *C. philippinensis* A. H. Clark); p. 39 (synonymy; station 282); p. 275 (listed).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 14 (discussion).

Comaster philippinensis A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 87, in remarks under *C. novaeguineae* (new name for the specimens of *C. novaeguineae* recorded by A. H. Clark from the Philippines).

Diagnostic features.—In general resembling *multibrachiata*, but smaller and less stout, with shorter cirri which have 8–11 segments. The arms are 37–63 (probably usually about 60 on fully grown examples). The color of preserved specimens is light brownish yellow.

Description.—The centrodorsal is discoidal, with a broad, flat, bare polar area from 2 to 2.5 mm. in diameter.

The cirri are slender, XXVII–XXX, 8–10 (usually 9), from 7 to 9 mm. long. The first segment is much broader than long, the second is about twice as long as its median width, and the third is the longest, three times as long as the median width. The fourth segment is somewhat shorter than the third and is a transition segment. The following segments gradually become shorter, the antepenultimate being about as long as broad and the penultimate slightly broader than long. The transition and following segments have slight dorsal processes.

The IIBr series are 4 (3+4); the IIIBr series are 2; the IVBr series are 2, but are rarely developed.

The 37–63 arms are 90 mm. in length. They are very slender and, with the division series, resemble those of the related species. The projection of the distal edges of the brachials is very marked.

Notes.—The description is based on 4 specimens from *Albatross* station 5356.

The larger specimen from *Siboga* station 282 has about 60 arms which are about 90 mm. long. The cirri are XXI, 10–11, from 8 to 9 mm. long. The smaller is in the 10-armed juvenile stage, the arms being 25 mm. long.

The specimen from Amboina Bay has 48 arms which are 110 mm. long. Of the 10 IIBr series, 6 are 4 (3+4) and 4 are 2. The centrodorsal is discoidal, with the dorsal pole circular, 3 mm. in diameter, and slightly concave. The cirrus sockets are arranged in two and a partial third crowded marginal rows. The cirri are XXXV, 8–9.

Localities.—*Albatross* station 5179; in the vicinity of Romblon; Romblon Light bearing S. 56° E., 4.5 miles distant (lat. 12° 38′ 15″ N., long. 122° 12′ 30″ E.); 68 meters; hard sand; March 25, 1908 [A. H. Clark, 1908] (4, U.S.N.M., 34959). Pl. 49, figs. 146, 147.

Albatross station 5356; North Balabac Strait; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long. 117° 18′ 45″ E.); 106 meters; January 5, 1909 [A. H. Clark, 1911] (4, U.S.N.M., 27486 [type], 34963, 35046, 36229, 36275). Pl. 48, fig. 145.

Albatross station 5142; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908].

Albatross station 5138; in the vicinity of Jolo; Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 35 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35037).

Albatross station 5137; in the vicinity of Jolo; Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 35040).

Albatross station 5136; in the vicinity of Jolo; Jolo Light bearing S. 37° E., 0.7 mile distant (lat. 6° 04′ 20″ N., long. 120° 59′ 20″ E.); 40 meters; sand and shells; February 14, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34974).

Albatross station 5174; in the vicinity of Jolo; Jolo Light bearing E., 2.6 miles distant (lat. 6° 03′ 45″ N., long. 120° 57′ 00″ E.); 36 meters; coarse sand; March 5, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 34964).

Albatross station 5147; Jolo Archipelago, in the vicinity of Siasi; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35044).

Albatross station 5153; Tawi Tawi group, Jolo Archipelago; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5° 18′ 10″ N., long. 120° 02′ 55″ E.); 89 meters; coral sand and shells; February 19, 1908 [A. H. Clark, 1908] (4, U.S.N.M., 34950).

Siboga station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Amboina Bay; about 100 meters; stones; March 2, 1922 (1).

Geographical range.—From the Philippines to the Lesser Sunda Islands.

Bathymetrical range.—From 35 (?27) to 106 meters; the average of 10 records is 56.7 meters.

History.—Specimens of this species were first recorded under the name of *Phanogenia novae-guineae* in 1908 by the present author, who listed them from 8 *Albatross* stations in the Philippines and gave a summary of their characters.

In 1909 I described in detail the articulation between the elements of the IBr series, referring the form to *Comaster novae-guineae.*

In 1911 in discussing the type specimen of Müller's *Alecto novae-guineae,* which I had recently examined in the Leyden Museum, I remarked that "it almost entirely lacks the rough and spinous character presented by the Philippine specimens recorded by myself as *novae-guineae.*" These last were the specimens mentioned above.

Early in 1910 I wrote a report on the third consignment of crinoids sent by the *Albatross* from the Philippines. Among these were 4 specimens (from station 5356) which I recognized as representing a new form, which I described in a paper published early in 1911 as *Comaster fruticosus.* No comparison was made at the time between these specimens and others previously received from the Philippines.

On my return from Europe in the autumn of 1910 I discovered that the *Albatross* specimens from the Philippines were quite different from Müller's type, and in the manuscript of my monograph on the crinoids of the Indian Ocean which I was then just completing I wrote that there is a strong possibility that *novae-guineae* may turn out to be synonymous with *typica,* since the type of *novae-guineae* at Leyden when compared with the specimen of *typica* in the same museum described by Carpenter is found to differ only in the lesser number of the arms and in its thinly discoidal centrodorsal on which are cirrus sockets. I continued that in this "case the Philippine form would require a new name; it might be appropriately called *philippinensis.*" These remarks were published in 1912.

In the original description of *Comaster sibogae,* published in 1912, I compared this species with it, and in 1918 I recorded a large and a small specimen in the *Siboga* collection.

COMASTER SIBOGAE A. H. Clark

Plate 51, Figure 152

Comaster sibogae A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 21 (description; *Siboga* station 318); Unstalked Crinoids of the *Siboga* Exped., 1918, p. VIII (discovery by the *Siboga* and its significance); p. 36 (in key; range); p. 40 (detailed description; station 318); p. 276 (listed); pl. 14, fig. 17.

Diagnostic features.—Very similar to *fruticosus* from which it differs in having the cirri longer and more slender, more than one-tenth of the arm length, with the longest segment from three to three and one-half times as long as the median width. The dorsal spines are more prominent than in *fruticosus.*

Description.—The cirri are XXII, 13, 13 mm. long. The first segment is short, the second is twice as long as the median width, the third is about three times as long as the median width, and the fourth and fifth are the longest, from three to three and one-half times as long as the median width. The following segments decrease rapidly in length so that the antepenultimate is slightly longer than broad, and the penultimate about as long as broad. The fifth is a transition segment. The segments following have small, but sharp and prominent, dorsal spines which are acutely triangular in end view. The opposing spine is subterminal, slender, and very sharp, in height equal to about one-third the lateral width of the penultimate segment. The terminal claw is nearly or quite twice as long as the penultimate segment, and is very slender and moderately curved basally, becoming nearly straight in the outer two-thirds.

The arms are about 60 in number, and are 100 mm. in length.

The terminal comb on the proximal pinnules has 11 or 12 teeth.

The mouth is subcentral and the anal tube submarginal.

Locality.—*Siboga* station 318; Java Sea, northeast of Madoera (lat. 6° 36′ 30″ S., long. 114° 55′ 30″ E.); 88 meters; fine yellowish gray mud; February 22, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.). Pl. 51, fig. 152.

Remarks.—*Comaster sibogae* is most nearly related to *C. fruticosus*, differing from that species chiefly in its proportionately longer and more slender cirri which have relatively longer segments and sharper and more prominent dorsal spines in the distal portion.

COMASTER SCHÖNOVI A. H. Clark

Plate 64, Figure 179

Comaster novaeguineae A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 141 (east coast of China; description of a specimen).

Comaster fruticosus A. H. CLARK, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (part; Malayan species; range and its significance).

Comaster schönovi A. H. CLARK, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 36 (in key; range); p. 36, footnote 1 (synonymy).

Diagnostic features.—Very similar to *fruticosus*, but with 12–13 short cirrus segments of which the longest are only half again as long as broad, or at most very slightly longer, instead of three times as long as broad as in *fruticosus*. The ninth or tenth and following segments are broader than long.

Description.—The cirri are XXXIII, 12–13, 12 mm. long. The first segment is short, the second is from one-third to one-half again as long as broad, and the third-fifth are half again as long as broad or rather longer, and somewhat constricted centrally. The following segments become shorter, the eighth and ninth being as long as broad and the remainder not so long as broad. The seventh and following segments have slightly everted distal dorsal ends. The opposing spine is small and short, but prominent, scarcely reaching one-third the width of the penultimate segment. The terminal claw is longer than the penultimate segment, stout, and comparatively slightly curved.

The arms are about 60 in number, 150 mm. long. The brachials are rather strongly overlapping, and the pinnule segments are finely spinous dorsally.

The general habitus is slender and delicate.

Localities.—East coast of China; Schönau, November 15, 1895 [A. H. Clark, 1909, 1913, 1915, 1918] (1, C. M.).

Singapore (1, C. M.). Pl. 64, fig. 179.

History.—As yet only these two specimens of this interesting species are known.

COMASTER PULCHER A. H. Clark

Plate 50, Figures 148, 149

Comaster pulcher A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 22 (description; *Siboga* station 257); Unstalked Crinoids of the *Siboga* Exped., 1918; p. 37 (in key; range); p. 40 (references; description; station 257); p. 275 (listed); pl. 14, figs. 14, 15.—GISLÉN, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 14 (discussion).

Diagnostic features.—There are about 40 arms. The cirri are composed of 15–17 segments, and their length is about one-sixth of the arm length.

Description.—The cirri are XXVII, 15–17, from 12 to 15 mm. long. The first segment is about twice as broad as long, the second is about twice as long as the width of the expanded ends and is strongly constricted centrally, and the third segment is from three to four times as long as the median width, constricted centrally, though not so much so as the preceding. The fourth segment is slightly over twice as long as the proximal width, and those succeeding rapidly decrease in length so that the seventh and following are about as long as broad. The fourth and following segments bear small subterminal tubercles, and also have the distal edge everted and prominent so that in lateral view they appear to bear dorsally a broad tubercle with a concave crest.

Of the IIBr series 9 are 4 (3+4) and 1 is 2. The IIIBr series are all 2 (1+2), the 3 which are absent being all external.

The 37 arms are 85 mm. long.

The mouth is central and the anal tube is submariginal.

Locality.—*Siboga* station 257; in Du-roa Strait, Kei Islands; 0–52 meters; coral bottom; December 11, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.). Pl. 50, figs. 148, 149.

Remarks.—The single specimen secured by the *Siboga* is the only example of this species which has so far come to light.

COMASTER BREVICIRRA (Bell)

Plate 29, Figures 84–86

[See also vol. 1, pt. 2, figs. 25, 26 (centrodorsal and radials), p. 20; fig. 135 (division series), p. 79; fig. 244 (arm), p. 199; figs. 422, 423 (pinnule tip), p. 257; figs. 635, 636 (comb), p. 323; fig. 697 (disk), p. 341]

Actinometra parvicirra (part) Bell, Proc. Zool. Soc. London, 1894, p. 396 (Macclesfield Bank).

Antedon brevicirra Bell, Proc. Zool. Soc. London, 1894, p. 400 (description; Macclesfield Bank, 20–35 fathoms).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 38 (synonym of *C. distincta*).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, p. 309 (in the *Spinifera* group; history; discussion); p. 310 (insufficiently described).—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 81 (identity).

Comaster parvus A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 144 (description; Andaman Is., 53 fathoms); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 533 (compared with *C. distincta*); Crinoids of the Indian Ocean, 1912, p. 88 (synonymy; detailed description; Andaman Is., 53 fathoms); fig. 3, p. 88; p. 315 (Andaman Is.; characters).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 82 Aru (Is.); p. 87 (definite locality; characters of the specimen).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 37 (in key; range); p. 41 (references; notes; stations 240, 274, 294); pp. 274, 275 (listed).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 10 (compared with *C. typica* [=*Comanthus parvicirra*]); p. 14 (discussion); Vidensk. Medd. fra Dansk naturh. Foren., vol. 83, 1927, p. 9 (Mortensen's station 20; notes); figs. 5, 6, p. 15.

Comaster distincta A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 87 (Macclesfield Bank; references to Bell); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (specimens from Macclesfield Bank); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 41 (references to Bell's specimens).

Diagnostic features.—The arms are about 40 (35–45 in fully grown individuals), from 60 to 70 mm. in length. The cirri are very short, one-eighth or one-ninth of the arm length, and are composed of 10–12 segments.

Description.—The centrodorsal is rather thick discoidal, with the cirrus sockets arranged in a single or partially double irregular marginal row.

The cirri are XIII–XVIII, 10–11, 8 mm. long.

The ends of the basal rays are visible as prominent tubercles in the angles of the calyx.

The radials project slightly beyond the edge of the centrodorsal. The IBr_1 are very short and bandlike, just in contact basally but with the greater part of their lateral edges widely diverging so that they are separated by a broad shallow **U**-shaped gap. The IBr_2 (axillaries) are triangular, twice as broad as long, with the distal angle very acute. The IIBr series are 4 (3+4), narrow, strongly rounded, and widely separated. The IIIBr series are 2 (1+2). The IVBr series are 2 (1+2), developed interiorly in reference to the IIBr series, but seldom present.

The arms are 40 in number, from 60 to 70 mm. in length, and, with the pinnules, resemble those of the other small species of the genus.

The disk is naked. The mouth is central or subcentral, and the anal tube is small, subcentral, or marginal.

The color in alcohol is yellowish brown.

Notes.—The specimen from the Andaman Islands, with no further data, is young, with 28 arms. The IIIBr series are arranged in 1, 2, 2, 1 order. One of the derivatives from a IBr axillary is undivided.

With this there were dredged 2 arms from a fully grown individual, and a 10-armed young with arms 23 mm. long.

The specimen from Sebesi Strait has 42 arms 70 mm. long. The cirri are XIX, 10–12 (usually 11).

The individual from north of western Java has 44 arms 80 mm. long. All of the IIBr series are 4 (3+4). The cirri are about XX, 10–11 (usually 11).

The largest individual from *Siboga* station 294 has 41 arms 100 mm. long. The cirri are XXIV, 11–13 (usually 12), 10 mm. long. Of the others, which are very small, 1 has 11 arms, and 2 have 10 arms only.

The largest example from *Siboga* station 240 has about 36 arms which are about 75 mm. long. The cirri are composed of 9–10 segments, and are 9 mm. long. Of the remainder, 1 has 11 arms 25 mm. long, 1 has 10 arms 45 mm. long, and the last has 10 arms 35 mm. long.

The specimen from the Aru Islands recorded by Reichensperger has 32 arms which are up to 70 mm. long. The **U**-shaped gap between the IBr_1 is clear and conspicuous. The cirri are XIX, 10–12, from 7 to 8 mm. long. The second cirrus segment is already somewhat longer than broad. The 3 following segments are much longer than broad. In the succeeding segments the length decreases, but the width increases somewhat. The color in life was deep black, with the tips of the pinnules yellow. The color in alcohol is a uniform yellowish brown.

The specimen from *Siboga* station 274 is young. It possesses 27 arms 55 mm. in length. The cirri are XIII, 10–11, 8 mm. long. It appears to belong to this species and not to *C. distincta* for the reason that the IIIBr series are developed externally as well as internally, both occurring on the same IIBr series. In *C. distincta* external IIIBr series are very exceptional.

Professor Bell's original description of *Antedon brevicirra*, which he assigned to the *Spinifera* group of *Antedon*, was as follows:

> Bidistichate, with flattened sides to brachials, 25 cirri of 9 joints, rather more than 40 arms, and a long first pinnule.
>
> Colour light brown.
>
> Macclesfield Bank, 20–35 fms.
>
> This species is so much broken that I should not have described it did I not wish to call attention to the short cirri set at the edge of the disc, recalling in every way the cirri of an *Actinometra*.

The specimen from Macclesfield Bank which served Professor Bell as the type of his *Antedon brevicirra* is small with numerous cirri and about 45 arms. The one recorded by Bell as *Actinometra parvicirra*, which has no indication of the depth at which it was taken, has between 35 and 40 arms.

The 4 specimens secured in Sagami Bay by Dr. Th. Mortensen show the following characters:

The centrodorsal is a rounded pentagon 4.2 mm. in diameter. The cirri are arranged in 2 rows. The cirri are XXI, 11, 8 mm. long. The fourth cirrus segment is the longest, twice as long as the median width. The 38+ arms are 90 mm. long. Gislén says that there were probably 41 arms in life. Of the 10 IIBr series 5 are 4 (3+4) and 5 are 2. The IIIBr series are 2 in 12 cases, and 4 (3+4) in 1 case. The arms, and especially the pinnules, are very spiny. The first arm syzygy is between brachials 1+2, and the second at about brachials 10+11. P_D bears a comb with 6–8 teeth. Pinnules with combs consisting of about 8 teeth occur here and there to about the thirtieth pinnule. The mouth is central.

The cirri are about XX, 11. The 38 arms are from 55 to 80 mm. in length. All of the IIBr series are 4 (3+4). All of the 11 IIIBr series are 2, and all but 1 of them are internally developed.

The cirri are XXIII, 12, 8 mm. long. The 29+ (probably 33) arms are from 40 to 60 mm. in length. The division series are as in the preceding specimen.

The cirri are XVIII, 10–11, from 6 to 7 mm. long. The arms are 6+6+5+5, with one ray broken, and thus probably 27 in the complete specimen; they are from 45 to 55 mm. long. The IIBr series are 2 in 5 cases, and 4 (3+4) in 3 cases. The 6 IIIBr series are all 2. The combs extend to about the thirteenth brachial. This is a rather young specimen.

Localities.—Investigator station 225; Andaman Islands (lat. 14° 38′ 15″ N., long. 96° 24′ 30″ E.); 97 meters; soft mud; March 24, 1897 [A. H. Clark, 1909, 1912] (12, U.S.N.M., 35047, 36200; I. M.). Pl. 29, figs. 84–86.

Investigator; Andaman Islands [A. H. Clark, 1912] (1, I. M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 90; Sebesi Strait, between Sumatra and Java; 36 meters; hard bottom; August 1, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 107; Java Sea, north of western Java (lat. 5° 47′ S., long. 106° 07′ E.); 49 meters; sand, stones, and sponges; August 5, 1922 (1).

Siboga station 294; off the southwestern coast of Timor (lat. 10° 12′ 12″ S., long. 124° 27′ 18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1918] (4, U.S.N.M., E. 434; Amsterdam Mus.).

Siboga station 240; anchorage at Banda, Moluccas; 9–36 meters; black sand and coral; lithothamnion bank; November 22–December 1, 1899 [A. H. Clark, 1918] (4, U.S.N.M., E. 432; Amsterdam Mus.).

Near Mimien, Aru Islands; 15 meters; coarse sand; April 8, 1908; Dr. H. Merton [Reichensperger,1913].

Siboga station 274; Aru Islands (lat. 5° 28′ 12″ S., long. 134° 53′ 54″ E.); 57 meters; sand, shells, and stones; December 26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Macclesfield Bank; 36–64 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Macclesfield Bank [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Mortensen's station 20; off Okinose, Sagami Bay, Japan; 110 meters; hard bottom; June 11, 1914 [Gislén, 1927].

Geographical range.—From the Andaman, Lesser Sunda, and Aru Islands, and the Moluccas, to the Macclesfield Bank and southern Japan.

Bathymetrical range.—From 15 (?9) to 110 meters. The average of 7 records is 56 meters.

History.—This species was originally described by Prof. F. Jeffrey Bell in 1894 from a specimen from the Macclesfield Bank under the name of *Antedon brevicirra.* At the same time he recorded a second specimen under the name of *Actinometra parvicirra.*

In 1909 I again described it as *Comaster parvus* from specimens dredged by the *Investigator* off the Andaman Islands. These were redescribed and figured in 1912.

In 1910 I examined Professor Bell's material in the British Museum and was much surprised to find that his *Antedon brevicirra,* which was quite unrecognizable from the published description, was in reality a species of *Comaster.* In 1913 I published a redetermination of Bell's specimens, but inadvertently assigned them to *C. distincta* instead of identifying them with *C. parvus* as I should have done.

In 1913 Dr. August Reichensperger recorded *C. parvus* from the Aru Islands, and in 1918 I recorded specimens from 3 *Siboga* stations.

In 1927 Dr. Torsten Gislén recorded as *C. parvus* some specimens which had been collected by Dr. Th. Mortensen in Sagami Bay, southern Japan.

Remarks.—Speaking of this species as illustrated by the specimens from Sagami Bay, Gilsén expressed himself as rather in doubt whether this form is in reality sufficiently differentiated from *C. serratus* to be designated as a separate species. He found the U-shaped gap between the IIBr series to be quite distinct in his specimens, while it is not marked in specimens of *C. serratus.* He noted also that the arms in *C. parvus* are longer and more numerous, IIIBr series occurring on the outer side of the IIBr series, and IVBr series being even sometimes present. He concluded that the species might therefore be regarded as valid.

I have not seen any Japanese specimens.

COMASTER DISTINCTA (P. H. Carpenter)

Plate 52, Figure 153

[See also vol. 1, pt. 1, fig. 320 (cirri), p. 275; pt. 2, figs. 418, 419 (pinnule tip), p. 255; figs. 638–642 (combs), p. 323]

Comatula, sp. P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 23, footnote 5.

Actinometra, sp. (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 41, footnote 2.

Actinometra distincta P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 295 (description; Samboangan, 10 fathoms; discussion); pl. 55, fig. 1.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 109 (systematic position).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1584 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 684 (assigned by Carpenter to the *Typica* group); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 748 (same); Crinoids of the Indian Ocean, 1912, p. 35 (identity).

Actinometra parvicirra (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 338 (Samboangan, 10 fathoms).

Comatula distincta A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 685 (listed); vol. 35, 1908, p. 124 (listed).

Phanogenia distincta A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203, footnote (arm structure; systematic position).

Comaster distincta A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 533 (*Albatross* stations 5356, 5401, 5414, 5477; compared with *C. serrata* and *C. parvus*); Crinoids of the Indian Ocean, 1912, p. 35 (=*Actinometra distincta* P. H. Carpenter, 1888); p. 36 (=*A. parvicirra* P. H. Carpenter, 1888, part); p. 38 (=*Antedon brevicirra* Bell, 1894); p. 87 (synonymy; summary of previous records; range); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (published references to specimens in the British Museum; localities represented [specimens from Macclesfield Bank=*brevicirra*]; characters of the specimens); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 37 (in key; range); p. 41 (references; stations 65*a*, 144, 153, 260, 289, 294, 305); p. 42, fig. 2 (normal and abnormal cirri); pp. 272, 273, 275, 276 (listed).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, pp. 14, 15 (discussion).

Diagnostic features.—The arms are 30–35 in number. The cirri have 9–13 segments, of which the longest is about twice as long as broad. This species is distinguished from *brevicirra* by the fewer arms, from *pulcher* by the fewer cirrus segments, from *serrata* by the lesser elongation of the longest cirrus segments, and from *tenella* by the greater number of arms.

Description.—The centrodorsal is a thick circular disk with the cirrus sockets arranged in 2 irregular and more or less alternating rows.

The cirri are about XXX, 12. Nearly all of the cirrus segments are longer than broad, and the distal have slight dorsal spines.

The radials are just visible beyond the rim of the centrodorsal. The IBr_1 are in contact laterally. The elements of the IBr series are short and broad, and are united by syzygy. The IIBr series are 4 (3+4). The IIIBr series are 2 (1+2).

There are, in the type specimen, 36 arms which are about 60 mm. long. The earlier brachials are oblong, the majority are triangular, broader than long, and the distal are wedge-shaped. The brachials have somewhat produced and overlapping distal ends. The anterior arms are long, slender, and slowly tapering, with 120–150 brachials. The posterior arms are shorter, rapidly tapering, with only 60–80 brachials. All of the arms are grooved.

Syzygies occur between brachials 1+2 and 9+10 or 10+11, and distally at intervals of 3 or 4 muscular articulations.

The pinnules decrease in length from P_D to those of the fourth and fifth brachials, and then increase again. The first 8 or 9 pinnules on each side bear a terminal comb which may occur at intervals as far as the thirtieth brachial.

The disk is 11 mm. in diameter. It bears a few calcareous nodules. The mouth is interradial, and the anal tube is almost marginal.

The color in alcohol is brownish white with dark spots on the mediodorsal line of the division series and first brachials, and in addition lateral spots on the outer elements of the IBr and proximal elements of the IIBr series.

The preceding description is based upon Carpenter's original description of the type specimen.

Notes.—The 2 specimens from *Siboga* station 65*a* are small and much broken.

The largest specimen from *Siboga* station 305 has about 30 arms which are about 75 mm. long. The dorsal pole of the centrodorsal is flat, 2 mm. in diameter. The cirri are XXI, 12–13, 10 mm. long. Another has 30 arms 70 mm. long. The cirri have 9–10 segments, and are 8 mm. long. One of the cirri is curiously modified, as described below. The 6 additional specimens are all small.

The 3 specimens from *Siboga* station 289 are all small. One has 16 arms 35 mm. long. There are 3 IIBr 4 (3+4) series, each bearing a IIIBr 2 series internally. Another has 12 arms 25 mm. long. There is a single IIBr 4 (3+4) series bearing a IIIBr 2 series internally developed. The third has 10 arms 25 mm. long.

Of the 5 specimens from *Siboga* station 294, the largest has 15 arms 30 mm. long. There are 2 IIBr 4 (3+4) series, 1 bearing internally a IIIBr 2 series, the other bearing 2 IIIBr 2 series. Another has 12 arms 25 mm. long. There is a single IIBr 4 (3+4) series which bears internally a IIIBr 2 series. A third has 10 arms 25 mm. long. The remaining 2 have each 10 arms 15 mm. long.

The largest specimen from *Siboga* station 144 has 21 arms. One ray bears only 2, with the other 4 regenerating. There are 11 cirrus segments. The other 2 each have 10 arms 22 mm. long.

The example from *Siboga* station 153 has about 34 arms 110 mm. long.

Of the 3 specimens from *Siboga* station 260, 1 is large, 1 is small, and 1 is very small with only 10 arms.

Of the 4 specimens from the Danish expedition to the Kei Islands station 24, 1 has 24 very slender arms 65 mm. long, 1 has 23 arms 60 mm. long, and the other 2 are small.

The specimen from the Danish Kei Islands expedition station 58 is small and broken.

The specimen from *Albatross* station 5356 has 30 arms 80 mm. long. The cirri are VIII, 10.

The specimen from *Albatross* station 5414 has 30 arms 80 mm. long. The cirri are XV, 11, from 7 to 8 mm. long.

Of the 2 examples from *Albatross* station 5477, 1 has 31 arms 100 mm. long, and the cirri XI, 11–12. The other is small with 20 arms 85 mm. long.

Of the 3 specimens from *Albatross* station 5401, 1 has 33 arms about 75 mm. long, and the cirri XXIII, 11. The other 2 are immature.

The specimen from Zamboanga determined by Carpenter as *Comanthus parvicirra* had apparently 21 arms. One cirrus remains, which has 12 segments. The characteristic terminal combs and the presence of combs on the distal pinnules show that this is a species of *Comaster* and not of *Comanthus*.

Abnormal specimen.—In the largest specimen from *Siboga* station 305, one of the cirri is curiously modified. (See vol. 1, pt. 1, fig. 320, *A*, p. 275.) It is composed of 8 segments and measures 5 mm. in length. The first 3 segments are of the normal type, but those following are strongly flattened dorsoventrally and greatly broadened, the normal distal dorsal spine being represented by 2, 1 at each of the distal angles of the segments.

Localities.—*Siboga* station 65*a*; off Saleyer, south of Celebes (lat. 7° 00′ 00″ S., long. 120° 34′ 30″ E.; 120–400 meters; pale gray mud, in the shallower water changing to a coral bottom; May 6, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 305; midchannel in Solor Strait, off Kampong Menanga; 113 meters; stony bottom; February 8, 1900 [A. H. Clark, 1918] (8, U.S.N.M., E. 425; Amsterdam Mus.).

Siboga station 289; southern coast of Timor (lat. 9° 00′ 18″ S., long. 126° 24′ 30″ E.); 112 meters; mud, sand, and shells; January 20, 1900 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Siboga station 294; southwestern coast of Timor (lat. 10° 12′ 12″ S., long. 124° 27′ 18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1918] (5, Amsterdam Mus.).

Siboga station 144; anchorage north of Salomakiëe (Damar) Island, northeast of Timor; 45 meters; coral bottom, with lithothamnion; July 7–9, 1899 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Siboga station 153; off the northern coast of Waigeu, northwest of New Guinea (lat. 0° 03′ 48″ N., long. 130° 24′ 18″ E.); 141 meters; fine and coarse sand with dead shells; August 14, 1899 (1, Amsterdam Mus.).

Siboga station 260; 2.3 miles N. 63° W. from the north point of Nuhi Jaan, Kei Islands (lat. 5° 36′ 30″ S., long. 132° 55′ 12″ E.); 90 meters; sand, coral and shells; December 16 and 18, 1899 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 24; 100 meters; hard bottom; April 15, 1922 (4); station 58; 290 meters; mud.; May 12, 1922 (1).

Albatross station 5137; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36 meters; sand and shells; February 14, 1908 (1, U.S.N.M., 35048). Pl. 52, fig. 153.

Challenger; Zamboanga, Mindanao, Philippines; 18 meters [P. H. Carpenter, 1888; A. H. Clark, 1913] (2, B. M.).

Albatross station 5356; north Balabac Strait; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8° 06′ 40″ N., long. 117° 18′ 45″ E.); 106 meters; January 5, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35045).

Albatross station 5414; between Cebu and Bohol, Philippines; Lauis Point Light bearing N. 67° W., 9.5 miles distant (lat. 10° 10′ 40″ N., long. 124° 02′ 45″ E.); 77 meters; temperature 16.89° C.; March 24, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35051).

Albatross station 5477; in the vicinity of Surigao Strait, between Samar and Leyte; Tacbuc Point (Leyte) bearing S. 87° W., 11 miles distant (lat. 10° 44′ 45″ N., long. 125° 12′ 30″ E.); 88 meters; gray mud; July 29, 1909 [A. H. Clark, 1911] (2, U.S.N.M., 35036, 35038).

Albatross station 5401; north of Cebu; Tanguingui Island Light bearing N. 79° W., 23 miles distant (lat. 11° 24′ 45″ N., long. 124° 06′ 00″ E.); 55 meters; fine sand; March 16, 1909 [A. H. Clark, 1911] (3, U.S.N.M., 35056).

Geographical range.—From the Lesser Sunda Islands to New Guinea, and northward to the Philippines and the Macclesfield Bank.

Bathymetrical range.—From 18 to 290 (?400) meters. The average of 14 records is 98 meters.

Thermal range.—One record, 16.89° C.

History.—This was one of the two species of *Actinometra* referred to by Carpenter in 1879 as being "very abnormal." The other was *Comaster multifida*, and the details of his reference to these two forms are given under that species.

At the same time he remarked that there were in the *Challenger* collection three species of *Actinometra* in which the anterior arms are longest, although all the arms, anterior and posterior alike, are grooved and bear tentacles. He never subsequently referred to this statement or indicated what the three species were. One of them, however, was the present form. The two others were forms now regarded as synonyms of *Comanthus timorensis* and *C. parvicirra*.

This species was originally described by Carpenter in 1888 from a single specimen which had been dredged by the *Challenger* in the Philippines.

In 1911 I recorded a number of specimens from 4 *Albatross* stations in the Philippines and compared the species with *Comaster serrata* and with *C. parvus* (=*brevicirra*).

Having examined the material in the British Museum in 1910, I announced in 1912 that Bell's *Antedon brevicirra*, described in the *Spinifera* group, is in reality the species previously described by Carpenter as *Actinometra distincta*. This was an error. Bell's *Antedon brevicirra* is the species I described in 1909 under the name of *Comaster parvus*.

One of the 6 specimens of *Actinometra parvicirra* dredged by the *Challenger* at Zamboanga and identified by Carpenter proved to be this species. This record was corrected in 1912, and again in a paper on the crinoids of the British Museum published in 1913.

In 1918 I recorded this form from 7 stations in the Dutch East Indies, at which it had been dredged by the *Siboga*.

COMASTER SERRATA (A. H. Clark)

Plate 52, Figure 154

[See also vol. 1, pt. 2, fig. 698 (disk), p. 341]

Comatula serrata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 154 (description; *Albatross* station 4895); p. 685 (listed).

Comaster parvicirra A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 306 (2 localities in Sagami Bay); vol. 39, 1911, p. 533 (Sagami Bay specimens really *C. serrata*).

Comaster serrata A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 317 (southern Japan); vol. 39, 1911, p. 533 (compared with *C. distincta;* identity of the Owston specimens from Sagami Bay); Crinoids of the Indian Ocean, 1912, p. 89 (range); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 37 (in key; range).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, pp. 17, 18 (discussion); Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 37 (Bock's stations 45, 55, 59; notes); figs. 21–25, p. 44); Zool. Bidrag från Uppsala, vol. 9, 1924, p. 77 (syzygies); fig. 64, p. 75 (syzygial face).

Phanogenia serrata A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus serrata A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Diagnostic features.—The arms are 30 in number, and the cirri have 9–11 segments, of which the longest is three times as long as broad.

Description.—The centrodorsal is discoidal, circular or more or less pentagonal in outline, moderately thick, with the somewhat convex polar area 2 or 3 mm. in diameter. The cirrus sockets are arranged in 2 crowded and irregular alternating rows.

The cirri are XXIV, 9–10, from 7 to 9 mm. in length. The first segment is not quite so long as broad, the second is from half again to twice as long as broad, and the third and fourth are the longest, approximately equal in length though the third is sometimes slightly the longer, about three times as long as the width of their ends. The following segments decrease rapidly in length so that the penultimate is little, if any, longer than broad. The fifth is a more or less marked transition segment. The second-fifth segments are strongly constricted centrally with expanded ends, this feature dying away distally. The fifth and following segments have the submarginal portion of the distal dorsal surface raised into a prominent transverse finely serrate ridge which at first is almost or quite straight and nearly or quite as broad as the distal width of the segment, but gradually becomes, in end view, narrower and more rounded, and finally sharply triangular, but not increasing in height or becoming more proximally situated. On the penultimate segment this gives place to a single terminal spine which is slender and prominent, though rather short, erect, subterminal to median in position, in height equal to one-fifth or one-fourth of the width of the segment. The terminal claw is long and slender, moderately curved, half again as long as the penultimate segment.

The ends of the basal rays are visible as rather prominent tubercles in the interradial angles of the calyx where they bridge over the narrow clefts between the radials and the centrodorsal.

The distal ends of the radials are even with the edge of the centrodorsal or extend slightly beyond it. The anterolateral angles of the radials are produced distally in the interradial angles where they entirely separate the bases of the IBr_1. The IBr_1 are very short, five or six times as broad as long in the median line, with the distal border straight and the proximal more or less convex so that the lateral length is usually not so great as the median. The IBr_1 are laterally widely separated by a broad U-shaped gap, and are united to the IBr_2 by a pseudosyzygy which usually consists of an ordinary synarthry modified by the presence of three or four concentric rows of uniform low tubercles in each ligament fossa, but which may be further modified by the resolution of the dorsal half of the longitudinal ridge into four or five converging radial ridges. The IBr_2 (axillaries) are broadly triangular, about twice as broad as long, with the anterior edges usually somewhat concave and bordered with short fine spines, and the lateral edges parallel to those of the adjoining IBr_2 and therefore making a broadly obtuse angle with those of the IBr_1. These lateral edges are about two-thirds as long as the lateral edges of the IBr_1. The IIBr series are 4 (3+4), widely separated. The $IIBr_1$ are interiorly united for slightly more than their proximal half, diverging at a broadly obtuse angle distally. The distal edges of the $IIBr_2$ and $IIBr_4$ are bordered with fine short spines. The IIIBr series are 2, two to each post-radial series, developed interiorly. Their two component elements resemble the $IIBr_3$ and $IIBr_4$.

The 30 arms are about 60 mm. long. The first 2 brachials are subequal, slightly wedge-shaped, from two to four times as broad as the exterior length, the first united interiorly for slightly more than the proximal half, diverging at a very obtuse angle distally. The next 3 brachials are almost oblong, about twice as broad as long, with the sides somewhat concave and the proximal and distal edges prominent and bordered with fine spines. The following brachials are very obliquely wedge-shaped or almost triangular, about as long as broad, with prominent and finely spinous distal ends and the sides and dorsal surface more or less concave, becoming gradually less obliquely wedge-shaped distally.

The mouth is central or subcentral, the anal tube lateral. The disk bears small scattered calcareous concretions which become more numerous on the anal area.

Notes.—One of Mr. Alan Owston's specimens from Sagami Bay (7036) has exactly 30 arms. The IIBr series are 4 (3+4) and the IIIBr series, which are only developed on the inner side of each postradial series, in other words in 1, 2, 2, 1 order, are 2 (1+2).

Owston's other specimen (7214) also has 30 arms, and is similar to the preceding.

The specimen from Bock's station 45 has the cirri XVI, 8–9, from 2 to 3 mm. in length. The third and fourth cirrus segments are three times as long as broad. The IBr_1 are three times as broad as long and laterally free. The IBr_2 (axillaries) are twice as broad as long. The ossicles following the IBr axillaries are free interiorly. The IIBr series are 4 (3+4), and the IIIBr series are 2. There are 13 arms 25 mm. in length. The brachials have strongly everted serrate distal ends. The distal brachials are from half again to twice as long as broad. P_1 to P_3 or P_4 have short high combs composed of 4 or 5 teeth. P_1 is from 2.5 to 3 mm. long, with about 25 segments. The distal pinnules are from 4 to 5 mm. long with 12–14 segments. None of the distal pinnules have combs. The disk is 2.5 mm. in diameter, and is somewhat elevated. The mouth is central. The anal tube is short, stout, and smooth, 0.8 mm. high and about the same in width.

In the specimen from Bock's station 55 the cirri are XIV, 9–10, from 4 to 6 mm. in length. The third and fourth cirrus segments are three times as long as broad. The radials are visible as narrow bands. The IBr_1 are three times as broad as long and laterally free. The IBr_2 (axillaries) are pentagonal, twice as broad as long. The ossicles following the IBr axillaries are interiorly united. There are 3 IIBr 4 (3+4) series, and 2 IIIBr 2 series. The 15 arms are 45 mm. long. The distal intersyzygial interval is 3 muscular articulations. The first 4 pinnules bear combs, that on P_1 having 5 and that on P_2 4 teeth. Beyond P_4 there are occasional combs, though these scarcely occur beyond P_{10}. As an example, on one arm there are combs on P_6 and P_9. The disk is 3 mm. in diameter. The mouth is subcentral. The anal funnel is large, swollen, and papillated, 1.5 mm. high. The color is light gray brown, with the disk dark brown.

In the specimen from Bock's station 59 the centrodorsal is 2.2 mm. in diameter, the bare dorsal pole being 1 mm. across.

The cirri are XVII, 10–11, from 5 to 7 mm. long, and are arranged in a single or double row on the centrodorsal. The first segment is short, the second is half again as long as broad and is somewhat constricted centrally, the third is three times as long as broad, and the fourth is somewhat shorter, two and one-half times as long as broad. The fifth is a transition segment. The dorsal spines are small and indistinct, and are situated on the distal portion of the segments. The penultimate segment is about as long as broad. The opposing spine equals in height about one-fifth the width of the penultimate segment. The terminal claw is about twice as long as the segment which bears it and is strongly curved.

The radials are concealed by the centrodorsal. The IBr_1 are four times as broad as long, and are partly concealed by the centrodorsal. The IBr_2 (axillaries) are almost triangular, three times as broad as long. The elements of the IBr series are united by syzygy. The IIBr series are 4 (3+4), and the IIIBr series are 2 (1+2). Beyond the IBr axillary the distal edges of the ossicles of the division series and of the brachials are everted and very spiny.

The 28 arms are from 50 to 70 mm. long, and 0.7 mm. in width. The first 7 brachials are oblong, and those succeeding have oblique ends. There are 16 brachials in 10 mm. of arm length, or 12 if syzygial pairs are counted as units. The distal brachials are half again as long as broad, slender and centrally constricted.

Syzygies occur between brachials 1+2, 10+11, 14+15, and 18+19 on all arms except those originating from a IBr axillary, on which the first syzygy is between brachials 3+4.

P_D and P_1 are 6 mm. long and are composed of 25–30 segments of which the first 11–13 have very spiny distal frills; the terminal comb has 6 teeth. P_2 is 5 mm. long with about 23 segments of which the 7 basal are spiny. P_3 is 3 mm. long with about 20 segments. P_4 is 2.5 mm. long with about 15 segments of which 5 bear teeth. The first 4 or 5 pinnules carry combs, which occur beyond on every second or third pinnule to about the twentieth. The teeth of the combs are half again as high as the width of the segments that bear them. The distal pinnules are 6.5 mm. long with 20 segments which, except the basal, are twice as long as broad with swollen and spinous ends.

The disk is 6 mm. in diameter, smooth and without granules. The mouth is central and the anal tube, which is papillated, is marginal.

The color is brownish.

Localities.—*Albatross* station 4893; Eastern Sea, from 10 to 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 29° E., 5.5 miles distant (lat. 32° 32′ 00″ N., long. 128° 32′ 50″ E.); 174–194 meters; gray sand, broken shells, and pebbles; bottom temperature 13.28° C.; August 9, 1906 (1, U.S.N.M., 36284).

Albatross station 4895; Eastern Sea, from 10 to 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 42° E., 4.7 miles distant (lat. 32° 33′ 10″ N., long. 128° 32′ 10″ E.); 174 meters; green sand, broken shells, and pebbles; August 9, 1906 [A. H. Clark, 1907] (1, U.S.N.M., 22657). Pl. 52, fig. 154.

Golden Hind; Sagami Bay, Japan (lat. 35° 02′ N., long. 138° 50′ E.); 100 meters; Alan Owston coll., 7036 [A. H. Clark, 1908, 1911] (1, U.S.N.M., 35039).

Golden Hind; Sagami Bay (lat. 35° 06′ N., long. 139° 42′ E.); 55 meters; April 24, 1902; or Sagami Bay (lat. 34° 59′ N., long. 139° 33′ E.); 110 meters; April 20, 1902; Alan Owston coll., 7214 [A. H. Clark, 1908, 1911] (1, U.S.N.M., 34966).

Dr. Sixten Bock's expedition to Japan station 45; Bonin Islands, east of Chichijima; 146 meters; July 31, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 55; Bonin Islands, eastnortheast of Chichijima; 210 meters; shells and sand; August 15, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 59; Bonin Islands, eastnortheast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922].

Geographical range.—Southern Japan from the Korean Straits to Sagami Bay, and the Bonin Islands.

Bathymetrical range.—From 100 to 174 (?210) meters; the average of the 3 depths accurately determined (174, 110, and 100 meters) is 128 meters. The depths given for Dr. Sixten Bock's stations represent the length of line out, not the actual depth.

Thermal range.—One record, 13.28° C.

History.—This species was originally described in 1907 as *Comatula serrata* from a specimen from the Korean Straits which had been dredged by the *Albatross* in 1906.

In the collection of Mr. Alan Owston of Yokohama, which was purchased and deposited in the United States National Museum by Mr. Frank Springer in 1907, there were 2 specimens which I recorded in 1908 under the name of *Comaster parvicirra.* I soon found that these in reality represented *C. serrata*, and in 1911 published a note to that effect.

In 1922 Dr. Torsten Gislén recorded 3 specimens from each of 3 of Dr. Sixten Bock's stations in the Bonin Islands.

COMASTER TENELLA, sp. nov.

Plate 51, Figures 150, 151

Comanthus (Comanthus) rotalaria A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 146 (Singapore, April 16, 1907, part).

Diagnostic features.—There are only 20 arms, which are about 65 mm. long, and the cirri, which are segregated in pairs or threes in the interradial angles, are XII, 10–11, and are rather weak and slender.

This species is more easily confused with *Comanthus parvicirra* than with any other species of *Comaster.*

Description.—The centrodorsal is very thin, discoidal, flat, 2 mm. in diameter. The cirrus sockets are segregated in the interradial angles, there being 2 or 3 in each angle.

The cirri are XII, 10–11, 6 mm. long. They resemble the cirri of *C. distincta* but are rather weaker and more slender, and the longest segments are slightly longer, about two and one-half times as long as broad.

The IIBr series are 4 (3+4). There is no further division.

The 20 arms are 65 mm. in length, and resemble those of *C. distincta*. The distal edges of the brachials are rather strongly produced and spinous.

Terminal combs occur sparsely on the middle and distal pinnules.

The color in alcohol is brownish white, with a median brown line on the division series and arm bases and occasional spots of brown on the arms.

Notes.—A young specimen from Singapore has 13 arms 35 mm. in length, and the cirri XII, 8–10, from 3.5 to 4 mm. long.

The specimen from the Danish expedition to the Kei Islands station 26 is small with 22 arms 40 mm. long. Of the 10 IIBr series 7 are 2 and 3 are 4 (3+4). Of the 2 IIIBr series one is 4 (3+4), externally developed, and the other is 2, internally developed. The specimen from station 30 has 19 arms 80 mm. long, with 9 IIBr 4 (3+4) series. The cirri are V, 11. Of the 2 examples from station 53, one has 20 arms 50 mm. long, and the other is small. The specimen from station 54 has 20 arms 65 mm. long; the cirri have 14–15 segments.

Localities.—Singapore; Svend Gad, April 16, 1907 [A. H. Clark, 1909] (7, U.S.N.M., E. 1087, type; C. M.). Same, October 23, 1910 (1, C. M.). Pl. 51, figs. 150, 151.

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 26; about 90 meters; sand; April 16, 1922 (1); station 30; about 40 meters; sand and shells; April 18, 1922 (1); station 53; 85 meters; sand and coral; May 9, 1922 (2); station 54 (1).

Geographical range.—From Singapore to the Kei Islands.

Bathymetrical range.—From the shore line down to about 90 meters.

Remarks.—In 1909 I failed to distinguish this form from *Comanthus parvicirra*, and the 7 specimens which I had examined were recorded as *parvicirra* ("*rotalaria*") in my report on the crinoids of the Copenhagen Museum.

COMASTER, sp.

Comaster, sp., A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 69.

Locality.—Macclesfield Bank, 42–46 and 47 meters.

Remarks.—In the British Museum there is from the lesser depth a specimen of some species of *Comaster* with 15 arms 55 mm. long. There are 3 IIBr series, of which 2 bear each a single IIIBr series. The cirri are VII, but apparently will be lost when the animal is fully grown.

There are 2 similar but smaller specimens from the greater depth.

COMASTER, sp.

Locality.—Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 54.

Remarks.—A small 10-armed specimen of a species of *Comaster* from this station probably represents *C. tenella*.

COMASTER, sp.

Locality.—Tahiti, Society Islands.

Remarks.—I have examined some detached arms of a species of this genus which are in the Munich Museum.

Genus COMANTHINA A. H. Clark

Actinometra (part) P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 210, and following authors.

Actinometra (part) Koehler, Mém. de la soc. zool. de France, vol. 8, 1895, p. 450.

Comaster (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Phanogenia (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124.

Comanthus (part) A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 204.

Comanthina A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (diagnosis; genotype *Actinometra nobilis* P. H. Carpenter, 1888); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 733 (in key; key to the Australian species); p. 752 (original reference: characters; range); Crinoids of the Indian Ocean, 1912, p. 9 (in Australia distinctive local species supplant the common East Indian species); p. 10 (does not extend beyond Hong Kong; absent from Japan; reason); p. 11 (represented in the Ceylon region; this the western limit of the large and highly multibrachiate forms); pp. 55, 56 (in keys); p. 91 (original reference; type); American Naturalist, vol. 49, 1915, p. 525 (bathymetric range); p. 539 (asymmetrical disk; 1 or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 34 (in key; range).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 52 (pinnule combs); p. 56 (discussion).

Comanthus (*Comanthina*) A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 143.

Diagnosis.—A genus of Comasterinae in which the elements of the IBr series and the first 2 ossicles following each axillary are united by synarthry; most of the axillaries bear either 2 division series or 2 arms; the IIBr series are 4 (3+4), and the IIIBr series are on the outer side of each ray 2 and on the inner side 4 (3+4), though this typical arrangement is subject to some variation, especially on posterior arms following IIBr 2 series.

Geographical range.—From the Macclesfield Bank and the Philippine, Caroline, and Solomon Islands to Queensland and the Abrolhos Islands, Western Australia, and westward to the Maldive Islands.

Bathymetrical range.—From the shore line down to 548 meters; but both the included species are chiefly sublittoral.

Remarks.—When fully grown the species of this genus have a characteristically massive appearance which distinguishes them at once. The division series are very broad and are flattened dorsally, and the perisomic areas between the division series and arm bases are always completely covered with a solid pavement of heavy plates.

The number of arms in *C. schlegelii* may reach 200, the largest number found in any comatulid. In *C. belli* there may be 150 or more arms.

The division series are subject to more or less irregularity, the outer IIIBr series being rather often 4 (3+4) instead of the normal 2; but the typical arrangement is almost invariably to be found on at least one ray.

The terminal combs are confined to the lower pinnules, and as a rule do not extend beyond P_7 or P_8, though in *C. schlegelii* they may occur at intervals as far as P_{20}.

Cirri are usually absent in *C. schlegelii*, though from 1 to 5 or 6—rarely more—may be present. In *C. belli* cirri may be absent, but a small number are usually present.

Whereas the adults of the two species of *Comanthina* are among the easiest of the comatulids to identify, young individuals, especially of *C. belli*, are exceedingly confusing. Young individuals of *C. belli* are very similar superficially to species of *Comaster*, and the smaller they are the greater is this similarity.

KEY TO THE SPECIES IN THE GENUS COMANTHINA

a^1. Proximal and middle pinnules with the segments in their basal portion produced dorsally into conspicuous dorsal processes which on the lower segments may be as high as the width of the segments themselves; cirri almost always present; distal cirrus segments with the distal dorsal edge slightly produced and with a dorsal carination or pointed dorsal tubercle (coast of Australia from the Abrolhos Islands northward and eastward to Torres Straits; 0–119 meters) -- **belli**, p. 458.

a^2. No dorsal processes on the basal segments of the earlier pinnules; cirri rarely present; if present, the distal segments are entirely smooth dorsally (Maldive Islands and Ceylon to northern Australia, the Solomon, Caroline, and Philippine Islands, and Macclesfield Bank; 0–278 meters) -- **schlegelii**, p. 466.

COMANTHINA BELLI (P. H. Carpenter)

Plate 53, Figure 157; Plate 73, Figure 199

[See also vol. 1, pt. 2, figs. 420, 421 (pinnule tip), p. 255; fig. 637 (comb), p. 323; pl. 24, fig. 1150 (disk)]

Actinometra belli P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 334 (description; station 186; remarks); pl. 64, figs. 1, 2.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 34 (division series compared with those of *Antedon* [*Himerometra*] *crassipinna*); p. 100 (closely related to *regalis, duplex,* and *nobilis*).—Koehler, Revue suisse de zool., vol. 3, 1895, p. 293 (differential characters).—Döderlein, Denkschr. d. medicin.-naturwiss. Gesellsch. Jena, ser. 8, vol. 5, 1898, p. 479 (Thursday I.); pl. 36, figs. 4, 4*a*.—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, pp. 204 and following (syzygies; regeneration); figs. K, L, M, p. 216 (from P. H. Carpenter).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Memoirs Australian Mus., vol. 4, part 15, 1911, p. 716 (identity; credited to Australia by Carpenter); p. 720 (of Döderlein, 1898=*C. multifida*+*C. belli*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 6 (referred to *Comaster*); Crinoids of the Indian Ocean, 1912, pp. 36, 39 (identity of previous records).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, pp. 5, 7 (identity).

Actinometra nobilis Bell, Proc. Zool. Soc., London, 1894, p. 394 (northwest Australia, 65 fathoms).—A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 719 (of Bell, 1894=*Comanthina belli*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 77 (of Bell, 1894=*Comaster belli*).

Actinometra multifida Bell, Proc. Zool. Soc. London, 1894, p. 394 (northwest Australia).

Comaster belli A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 6 (various localities; descriptions of specimens; discussion, and comparison with related forms); p. 7 (proximal pinnules compared with those of *Comantheria grandicalyx*); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 308 (localities; discussion); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 11 (published references to specimens in the British Museum; localities represented; characters of the specimens); Records of the Western Australian Mus., vol. 1, part 3, 1914, p. 113 (already recorded from Houtman's rocks); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 224 and following (detailed account of the distribution in Australia); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 35 (in key; range).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, pp. 5, 7 (history); p. 15 (range; not found by the Carnegie Exped., 1913); pp. 192 and following (range).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 100 (pinnule processes).

Phanogenia belli A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus belli A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 149 (proximal structures compared with those of *Uintacrinus*).

Comanthina belli A. H. Clark, Amer. Journ. Sci., ser. 4, vol. 32 (old ser. vol. 182), 1911, p. 130 (significance of distinctive characters); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 437 (northwest Australia, 65 fathoms); p. 440 (Australian tropical species; occurs south to Shark Bay and Torres Strait); p. 443 (range on east coast); p. 444 (range on west coast); p. 455 (localities; characters; abnormal specimen); p. 456 (may or may not retain cirri); p. 465 (association with other species); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 717 (known to Carpenter from Australia); p. 721 (occurs south to Cape York); p. 723 (northwest Australia); p. 724 (peculiar to north Australia); p. 733 (in key); p. 752 (annotated synonymy; characters; summary of Australian records); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 6 (placed in *Comaster*, near *C. typica*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 390 (Mermaid; description); p. 391 (southwest Australia); Crinoids of the Indian Ocean, 1912, pp. 36, 39 (identity of previous records); p. 91 (synonymy; summary of previous records; range); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 313 (rectification of generic reference in previous memoir in this series).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 234 (southwest Australia; of the 2 specimens that from Shark Bay is in the Hamburg Mus., and that from Port Hedland at Perth; Broome, No. 6137).

Comantheria belli A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 716 (reference to *Challenger* specimen); p. 723 (Mermaid).

Comaster typica A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, pp. 439, 444, 453 (Port Hedland; descriptions of young specimens); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 6 (preceding records determined as this species); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 308 (same).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 234 (northwest Australia, No. 3433; southwest Australia, No. 5968).

Comanthus schlegelii (part) H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 101 (Maër, 18 fathoms); The Echinoderm Fauna of Torres Strait, 1921, p. 20 (same; characters; color).

Diagnostic features.—The arms are 60–150 or more in number in fully developed individuals. From all the other comasterids with a large number of arms this species is easily distinguished by the conspicuous carinate processes on the lower segments of the proximal and middle, and on the ungrooved arms also of the distal, pinnules, combined with the occurrence of IIIBr series which on the outer side of the rays are typically 2, but on the inner side 4 (3+4).

From *Comanthus plectrophorum*, which possesses similar carinate processes on the lower segments of the proximal and middle pinnules, *Comanthina belli* is distinguished by the greater number of arms (40–44 in *plectrophorum*), the fewer cirri, and the much smaller number of cirrus segments, not more than 20 as contrasted with 29–37 in *plectrophorum*.

Description.—The centrodorsal is small, thin discoidal, roughly circular to subpentagonal in outline, nearly or quite 5 mm. in diameter, with the cirrus sockets, which are of very diverse sizes, arranged in a single marginal row. The dorsal pole is concave and there is a shallow circular pit in the center. On the border of the centrodorsal, as viewed dorsally, the portion of the edge adjacent to the larger cirrus sockets is usually slightly swollen.

The cirri are VII–VIII, 15–17, most commonly 16, about 17 mm. in length. They are well developed, though rather small and weak considering the size of the animal. They vary in any given individual from slender to rather stout. The first segment is very short, and those following gradually increase in length to the sixth or seventh, which are from slightly longer than broad in the stoutest cirri to twice as long as broad in the most slender, and then slowly decrease so that the last

2 or 3 before the penultimate are nearly or quite twice as broad as long. The ninth or tenth is a transition segment with a narrow terminal band light in color and with a highly polished surface like the following segments. On the transition segment there is a slight thickening of the dorsal portion of the distal edge which on the 6 or 7 preceding the penultimate becomes a small pointed conical terminal dorsal tubercle. The opposing spine is small, but little larger than the tubercles on the preceding segments, conical, arising from the entire dorsal surface of the penultimate segment, with the apex median to subterminal. The terminal claw is from half again to twice as long as the penultimate segment, moderately stout, evenly tapering and evenly curved, or more strongly tapering and more strongly curved in the proximal half than distally.

The ends of the basal rays are visible as minute tubercles in the interradial angles.

Very little, if any, of the dorsal surface of the radials is concealed by the centrodorsal. The radials are short, their distal width being about four times their length; their distal border is concave, and the anterolateral angles are broadly rounded. The IBr_1 are short and broad, about twice as long as the radials, five or six times as broad distally as the median length, with the distal border straight. The proximal two-thirds or three-fourths of the lateral borders of adjacent IBr_1 are united, these borders beyond the point of union diverging at usually a right angle. The IBr_2 (axillaries) are triangular with the lateral angles slightly truncated, twice as broad as long. The anterior angle is approximately a right angle, and the anterior sides are almost straight. The IIBr series are broad, 4 (3+4), or exceptionally 2. Interiorly the first 2 elements are in lateral contact, but the syzygial pairs are free. Exteriorly the IIBr series on adjacent rays are separated by a space equal to from one-quarter to one-half of their width. The IIIBr series are 2 exteriorly, and 4 (3+4) interiorly; but this order is reversed following IIBr 2 series. The IVBr series are 2. The VBr series are 2, or rarely 4 (3+4). The VIBr series are 4 (3+4), but are seldom developed. Beyond the IIIBr axillary, which bears on the inner face a IVBr 2 series and on the outer an undivided arm, the succeeding axillaries typically bear on one face a division series and on the other an undivided arm, which alternate in position in the successive divisions.

The dorsal perisome is completely covered with unusally solid plates which are very irregular in size and arrangement. There may be between the IIBr series on adjacent rays 2 or 3 large plates, or a single plate resting on the anterolateral angles of the IBr_1 which is followed by 2 columns of polygonal plates, or simply a mass of plates of various sizes showing no definite arrangement. The plating between the IIBr series on adjacent rays runs distally and tapers to a point between the basal segments of P_D. Interiorly the IIBr series are connected by a narrow strip of heavily plated perisome.

The arms are 65–150 or more in number, from 105 to 215 mm. in length. They are narrow at the base, slowly increasing in width to about the fifteenth brachial and thence tapering distally, this feature being much more noticeable on some arms than it is on others. The first 2 brachials are approximately equal in size and shape, slightly wedge-shaped, twice as broad as long. The first brachials are interiorly united for the proximal two-thirds. The first syzygial pair (composed of brachials 3+4) is from half again to twice as broad as long. The next 3 brachials are oblong, about two and one-half times as broad as long, those succeeding becoming very obliquely wedge-shaped or triangular, twice as broad as long, after the proximal third of the arm becoming gradually less obliquely wedge-shaped, but of the same relative length, and slightly longer distally. The division series and first 2 brachials are perfectly smooth dorsally, but from the fourth onward the brachials have moderately produced and overlapping distal edges.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 15+16 (usually in the vicinity of the thirteenth brachial), and distally at intervals of from 4 to 9 (usually 4) muscular articulations.

P_D is moderately stout basally, but tapers rapidly and is exceedingly slender in the distal two-thirds. The terminal comb consists of 7–11 moderately large roundedly spatulate teeth. The pinnule is 20 mm. long. P_P and P_1 are nearly as long, similar, but less stout basally. P_2 is about 7 mm. long, slender and delicate. The following pinnules gradually become longer and stouter, with large gonads, and then more slender again distally. The distal pinnules are very slender, and about 10 mm. long. From P_3 onward the pinnules have the third-fifth or third-seventh segments produced into long high narrow carinate processes which on the lower segments may be as high as the width of the segment that bears them. This modification of the proximal segments gradually dies away after about the middle of the arm. The terminal comb persists to about P_7.

The disk is from 25 to 30 mm. in diameter, and carries a variable number of small granules, which are especially numerous along the ambulacral grooves. The mouth is interradial. A varying number of the posterior arms are ungrooved.

The color in alcohol as described by Carpenter is darkish brown with a dark mediodorsal line, the pinnules sometimes tipped with green. A dry specimen at hand from Torres Strait is olive brown, darker on the ventral surface, the pinnules tipped with brilliant greenish yellow; the gonads are brown, but bright red by transmitted light. Another dry example from the same locality is light olive brown with a dark mediodorsal line, becoming blackish in the outer half of the arms; the pinnules are buff and black in broad bands.

Notes.—The specimen from the Abrolhos Islands has 73 arms which are about 85 mm. long. The cirri are VI, 14–16, from 10 mm. to 12 mm. long.

The specimen from Freycinet Reach, Shark Bay, has about 120 arms of which the anterior are about 120 mm. and the posterior about 80 mm. in length. The left posterior ray and its derivatives, and the adjacent halves of the neighboring rays, are devoid of ambulacral grooves. Many of the arms on the other rays have rudimentary ambulacral grooves, or none at all. The genital pinnules are rarely grooved. Wherever it is exposed the dorsal perisome is heavily plated. The centrodorsal is thin discoidal, 4.5 mm. in diameter, with the dorsal pole strongly concave. Three cirri, which are equally spaced, remain. These are comparatively long, 13 mm. in length, and moderately stout, with 16 segments, of which the first is short, those following gradually increasing in length and becoming about as long as broad on the fourth; the fifth-eighth are slightly longer than broad; those succeeding are about one-third, or rather less, broader than long and bear subterminal tubercles which in the last 3 are moderately sharp.

The adult specimen from Port Hedland has about 150 arms which are about 100 mm. long. Three of the IIBr series are 2 and 7 are 4 (3+4). On all 3 of the IIBr 2 series the normal order of the IIIBr series is reversed, these being 4 (3+4) externally and 2 internally. On one of the other IIBr series there are 2 IIIBr 4 (3+4) series. About half a dozen of the outer division series are 4 (3+4) instead of the usual 2. All the other division series are regular. The centrodorsal is only slightly raised above the dorsal surface of the radial pentagon. It is irregularly pentagonal in shape, with partially obliterated cirrus sockets about the periphery. One fully developed cirrus 11.5 mm. in length with 16 segments remains, and there are 2 rudimentary cirri. The dorsal portion of the perisome between the division series is heavily plated. The color is dull yellowish white, with the dorsal perisomic areas and the extreme borders of the division series yellow brown. The sides of the undivided arms are usually darker than the dorsal surface, sometimes a deep yellow brown. Some of the free arms have a more or less perfectly developed dark brown mediodorsal stripe.

One of the three young specimens from Port Hedland has 67 arms 65 mm. long. The centrodorsal is thin discoidal, small, the bare dorsal pole being 2 mm. in diameter. The cirri are XX, 14–16, 9 mm. long. The first cirrus segment is short, the fourth is about as long as broad, the sixth or seventh is the longest, from one-third to one-half again as long as broad, and the last 6 or 7 are about as long as broad. The outermost 7 or 8 bear blunt spines or tubercles on the distal dorsal border. The longer earlier segments are slightly constricted centrally, but this feature is scarcely noticeable. The color is grayish white, with a median stripe of darker on the arms. The interradial perisome is heavily plated.

A second specimen has 59 arms 60 mm. long. The cirri are VII (plus 9 undeveloped), 15, 10 mm. long. The dorsal perisome is completely plated, but the plates are small. The color is yellow brown, with traces of a broad mediodorsal band of darker.

The third specimen is similar, but smaller.

These 3 specimens differ considerably in the number of arms, and in each there is large variation in the number of arms on the different rays. Regenerating division series and arms are frequent in all of them.

One of the 2 specimens from Broome has 73 arms 135 mm. long. The cirri are XVII, 11 mm. long. There are a few small scattered nodules on the disk. The color is grayish brown.

The other specimen from Broome has 68 arms 125 mm. long. The cirri are XIV. The disk is thickly studded with small calcareous nodules. The color is bright yellow green, with the centrodorsal and cirri light slaty.

In the specimen from Western Australia the cirri are XII, 17–18, 13 mm. long. There are slight dorsal tubercles on the last 6 segments. The carination of the earlier pinnule segments is very prominent.

The specimen from northwestern Australia has VII cirri.

In the arm fragments from Mermaid the extravagant dorsal processes on the third-fifth, and to a lesser degree the sixth, pinnule segments prove conclusively that these fragments must belong to this species. They agree very closely with the corresponding parts of the arms in a specimen at hand from Torres Strait.

Professor Döderlein recorded 2 specimens from Thursday Island. A small individual with a maximum arm length of 30 mm. in which 2 rays are in process of adolescent autotomy does not exhibit the keels on the basal pinnule segments which are so characteristic of large examples. The color in alcohol is pale yellowish.

The 2 specimens from Mer are both small. According to H. L. Clark the cirri are XX–XXI, 15–17. One has 60 and the other 70 arms. In the specimen with 60 arms 4 rays are typical, but the fifth has the normal arrangement reversed, the inner IIIBr series being 2 and the outer 4 (3+4). In the specimen with 70 arms only 2 rays show the typical arrangement, each of the other rays having an inner IIIBr series 2 instead of 4 (3+4).

The color of one of the individuals in life was described as having been black, passing into olive at the tips of the arms; the distal half of each pinnule was chrome yellow, passing through brown into the dull olive or black of the basal half; the cirri were lemon yellow. The other was recorded as strikingly different, bewilderingly variegated with shades of yellow, green, brown, blackish, and white, giving the general impression of being bright yellow with black markings; the cirri were yellow with 2 dusky dark bands.

The specimen from the Great Barrier Reef is small, with 55 arms which are about 100 mm. long. The cirri are XVIII, 15, short and stout, with the segments subequal, the distal being only very slightly shorter than the proximal. There are no dorsal processes. With the specimen is a color note, "deep purplish blue, the pinnules purple with yellow tips; cirri lemon yellow."

In Carpenter's original account of this species, which was based on 3 specimens from *Challenger* station 186, he described the centrodorsal as being a moderately thick circular disk hollowed in the center.

The cirri are fairly stout, about XV, 15–20, with a few of the segments rather longer than broad.

There are 65–70 arms which are about 105 mm. long. The anterior arms are long and slowly tapering, with 120–150 overlapping brachials which are shortly triangular at the base, becoming quadrate about the middle and slightly elongated near the tip. The posterior arms are shorter, with only 80–100 brachials, and taper more rapidly.

P_D is moderately stout and reaches 20 mm. in length. P_P on the inside of the ray and P_1 are nearly as long. But P_a is only half their length, and much more slender, while P_2 and P_b are the smallest on the arm. The terminal pinnules are long and slender on the anterior arms, but shorter on the posterior ones. The basal segments of the genital pinnules have sharp dorsal keels which are less distinct in the first few pinnules than in those immediately following. In the anterior arms they are lost after about the fiftieth brachial, but they are traceable to near the end of the posterior arms. The lowest pinnules have a well-marked comb which becomes gradually smaller and is lost at about the fifteenth brachial.

The disk is 30 mm. in diameter. It bears a variable number of small granules, especially along the ambulacral grooves. Several of the posterior arms are ungrooved. The dorsal perisome is regularly plated as far as the IIIBr axillary.

Localities.—Abrolhos Islands (Houtman's Rocks), Western Australia [A. H. Clark, 1912, 1913] (1, H. M.).

Hamburg southwest Australia expedition station 14; Shark Bay; Freycinet Reach, west of Middle Flat as far as the northern point of Heirisson Prong; 11–16 meters; bottom at first sandy, later rock with coral; September 12, 1905 [A. H. Clark, 1911] (1, H. M.).

Port Hedland, Western Australia (lat. 20° 17′ S., long. 118° 34′ E.); July, 1905 [A. H. Clark, 1911] (4, Berl. M.; H. M.; W. A. M.). Pl. 73, fig. 199.

Southwestern Australia [A. H. Clark, 1912]. The 2 specimens referred to are the 1 from Shark Bay and the large 1 from Port Hedland.

Broome, Roebuck Bay, Western Australia; July, 1905 [A. H. Clark, 1912, 1913] (2, Berl. M., 6137; H. M.).

Western Australia [A. H. Clark, 1913] (1, B. M.).

Northwestern Australia [Bell, 1894; A. H. Clark, 1913] (1, B. M.). Same, 119 meters [Bell, 1894].

Mermaid, northwestern Australia; *Gazelle* [A. H. Clark, 1911, 1912] (arm fragments, Berl. M., 2157).

Thursday Island [Doderlein, 1898].

Mer, Murray Islands, Torres Strait; 33 meters; H. L. Clark, October, 1913 [H. L. Clark, 1915, 1921] (2, M. C. Z., 586).

Great Barrier Reef, 4 miles eastnortheast of Mer, Murray Islands; H. L. Clark, October 15, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 549).

Challenger station 186; Prince of Wales Channel, Torres Strait (lat. 10° 30′ N., long. 142° 18′ E.); 15 meters; September 9, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (2, B. M.).

Torres Strait [A. H. Clark, 1911, 1912] (2, U.S.N.M., 36166, 36171). Pl. 53, fig. 157.

Geographical range.—Coasts of Australia, from the Torres Strait region westward and southward to Shark Bay and the Abrolhos Islands.

Bathymetrical range.—Littoral and sublittoral; the greatest recorded depth is 119 meters.

Remarks.—*Comanthina belli* is a very curious form. Large specimens are in superficial appearance strikingly like similarly large specimens of *Comanthina schlegelii*, both species agreeing in possessing a unique type of arm division. The terminal combs of *belli* and the arm division beyond the IIIBr series, however, approach the type characteristic of *Comaster*, and I find that, taking all the characters together, the smaller the individual the greater is the resemblance to the species of *Comaster*, and the greater is the difference from similar small specimens of *Comanthina schlegelii*.

History.—This species was originally described by Dr. P. H. Carpenter in 1888 from 3 specimens which had been collected by the *Challenger* in 1874. In 1894 additional specimens were recorded by Prof. F. Jeffrey Bell as *Actinometra nobilis* and *Actinometra multifida*, and in 1898 Prof. Ludwig Döderlein published additional records from Thursday Island.

In my report on the crinoids collected by the Hamburg southwest Australian expedition which appeared in 1911 I recorded and gave notes upon a specimen from Port Hedland and another from Shark Bay, and at the same time described 3 small individuals from Port Hedland under the name of *Comaster typica* which are in reality this form. In my monograph on the crinoids of Australia which was published in the same year I gave an annotated synonymy, with the differential characters, and a summary of the known records. Two previously unnoticed specimens from Torres Strait in the United States National Museum and one from Mermaid which had been collected by the *Gazelle* were mentioned.

In a memoir on the crinoids of the Hamburg Museum published in 1912 a specimen from the Abrolhos Islands and 2 from Broome were recorded and their main characters were given. The 3 small individuals which had been described under the name of *Comaster typica* in 1911 were here redetermined as *C. belli*. A discussion of the characteristic features of this species was included.

In my monograph on the crinoids of the Indian Ocean published in 1912 there was given a summary of the known information concerning this form.

In my account of the crinoids of the Berlin Museum published in 1912 fragments of a specimen are recorded from Mermaid, and in a supplement to my memoir (1911) on the crinoids collected by the Hamburg southwest Australia expedition published in 1913 the 3 small specimens originally described under the name of *Comaster typica* are redetermined as *C. belli*.

The 2 specimens which were recorded by Dr. H. L. Clark as *Comanthus schlegelii* from Mer proved on reexamination to belong to this species.

In 1915 I discussed the range of this species in Australia, and in 1918 in my report on the unstalked crinoids of the *Siboga* expedition I inserted this form in a key to the species of *Comaster*.

In 1921 Dr. H. L. Clark published a detailed account of its distribution and occurrence. He remarked that he did not meet with the species; but the 2 specimens from the deeper water outside the northwestern reef at Mer which he mentions under *Comanthus schlegelii* are in reality this form.

The generic allocation of this species has been unusually varied. Up to 1908 it was always referred to *Actinometra*. In that year I assigned it first to *Comaster* and then to *Phanogenia*, both of these generic names being used in a very broad sense. In 1909, on the establishment of the genus *Comanthus*, I placed it in this genus. In 1911 I referred it to *Comanthina*, which I regarded as a subgenus of *Comanthus*, and it is found so allocated in the report on the crinoids of the Hamburg southwest Australia expedition, the monograph of the crinoids of Australia, the monograph of the crinoids of the Indian Ocean, and in the report upon the crinoids of the Berlin Museum. In the introduction to the monograph on the crinoids of Australia it is in one place through an oversight assigned to *Comantheria*, though also on the same page, as well as elsewhere, to *Comanthina*. In the report on the crinoids of the Hamburg Museum it is placed in *Comaster*, restricted, and the reasons for this are given. Since that time (1912) it has remained in *Comaster*. But I am now convinced that it should be placed in *Comanthina*.

COMANTHINA SCHLEGELII (P. H. Carpenter)

Plate 53, Figure 158; Plate 54, Figure 159; Plate 55, Figures 160, 161; Plate 64, Figure 180

[See also vol. 1, pt. 1, fig. 163 (dorsal view), p. 225; fig. 164 (dorsal view), p. 227; figs. 165, 166, 168–170 (centrodorsal), p. 229; pt. 2, fig. 138 (division series), p. 79; figs. 424, 425 (pinnule tip), p. 257; figs. 643–645 (comb), p. 323; fig. 699 (disk), p. 341; pl. 17, figs. 1074, 1075 (oral pinnules); pl. 24, fig. 1153 (disk)]

Actinometra novae-guineae P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 386.

Actinometra, sp. nov. P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, pl. 2, fig. 1 (diagram of the disk ambulacra).

Comatula novae-guineae P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 195 (Banda).

Actinometra schlegelii P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 210 (description; ?East Indies).—Bell, Proc. Zool. Soc. London, 1882, p. 534 (listed).— A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (identity); Crinoids of the Indian Ocean, 1912, p. 36 (identity).

Actinometra schlegeli Bell, Proc. Zool. Soc. London, 1882, p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 732 and following (discussion of Bell's method of formulation and corrected formula); *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 55 (80 or more arms); vol. 26, pt. 60, 1888, pp. 59, 331, 347, 367, 383 (discussion).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).

Actinometra nobilis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 10, pt. 32, 1884, pp. 55, 57, 69, 110, 111 (large number of arms; specific formula; ungrooved arms present on each ray; absence of disk ambulacra leading to posterior arms; genital cord; ovaries).—von Graff, *Challenger* Reports, Zoology vol. 20, pt. 61, 1887, p. 13 (Samboangan; myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 336 (description; station 208; also Samboangan); pl. 65.—Hamann, Jenaische Zeitschr., vol. 23, 1889, p. 234 (anatomy).—Cuénot, Archives de biol., vol. 11, 1891, p. 315 (anatomy).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 34 (division series compared with those of *Antedon* [*Himerometra*] *crassipinna*); p. 100 (closely related to *belli*, *duplex*, and *regalis*).—Walther, Einleitung in die Geologie als historische Wissensch., 1894, p. 298 (from Carpenter).—Koehler, Revue suisse zool., vol. 3, 1895, p. 293 (differential characters).—Wheeler, Mitt. zool. Stat. Neapel, vol. 12, Heft 2, 1896, p. 244 (relation to *Myzostomum platypus*).—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, p. 219 (regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Notes from the Leyden Mus., vol 33, 1911, p. 179 (synonym of *schlegelii*); Crinoids of the Indian Ocean, 1912, p. 36 (synonym of *schlegelii*); p. 39 (of Bell, 1894=*belli*).

Actinometra dissimilis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 110 (specific formula [Samboangan, 10 fathoms]); p. 111 (genital cord); vol. 26, pt. 60, 1888, p. 337 (identity).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 439 (history and status of the name).

Actinometra multifida Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 169 (Percy I., Queensland).

Actinometra duplex P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 335 (description; Banda, 17 fathoms); pl. 64, fig. 3.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 34 (division series compared with those of *Antedon* [*Himerometra*] *crassipinna*); p. 100 (closely related to *regalis*, *belli*, and *nobilis*).—Bell, Proc. Zool. Soc. London, 1894, p. 396 (Macclesfield Bank, 13 fathoms).—Koehler, Revue suisse zool., vol. 3, 1895, p. 293 (differential characters).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 179 (synonym of *schlegelii*); Crinoids of the Indian Ocean, 1912, p. 36 (of P. H. Carpenter, 1888=*schlegelii*); p. 38 (of Bell, 1894=*schlegelii*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 75 (identity of specimens in the British Museum).

Actinometra regalis P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 347 (description; Banda, 17 fathoms); pl. 68.—Wachsmuth and Springer, Proc. Acad. Nat. Sci., Philadelphia, 1890, p. 347 (perisomic plates).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 5 (noteworthy on account of the number of individuals in Brock's collection from Amboina); p. 11 (collected by Brock at Amboina); p. 34 (division series compared with those of *Antedon [Himerometra] crassipinna*); p. 99 (Amboina; description of the specimens; closely related to *belli*, *duplex*, and *nobilis*); p. 113 (in Göttingen Mus.).—Bather, Ann. Report Museums Assoc. for 1891, 1892, p. 97 (example of a free crinoid).—Koehler, Revue suisse de zool., vol. 3, 1895, p. 292 (Bay of Amboina; notes).—Döderlein, Denkschr. d. medicin.-naturwiss. Gesellsch. Jena, vol. 8, Heft 5, 1898, p. 480 (Amboina).—Minckert, Archiv f. Naturgesch, Jahrg. 71, 1905, vol. 1, Heft 1, p. 219 (regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 179 (synonym of *schlegelii*); Memoirs Australian Mus. vol. 4, 1911, p. 720 (of Döderlein, 1898=*schlegelii*); Crinoids of the Indian Ocean, 1912, p. 36 (of P. H. Carpenter, 1888=*schlegelii*); p. 37 (of Hartlaub, 1891=*schlegelii*); p. 38 (of Bell, 1894=*Comaster multibrachiata*); p. 39 (of Döderlein, 1898=*schlegelii*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (of Bell, 1894=*Comaster fruticosus*).

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Comanthus duplex A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 205 (*Albatross* station 5145); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 397 (*Albatross* station 5252); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus regalis A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus schlegelii A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed)—H. L. Clark, Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 84 (2 specimens, one of which has about 120 arms; Ceylon); p. 93 (occurs at Ceylon); The Echinoderm Fauna of Torres Strait, 1921, p. 8 (collected by the Carnegie Exped., 1913); p. 20 (Mer; Port Galera, Mindoro, P. I.; notes); pp. 192 and following (range).

Comanthus (Comanthina) nobilis A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 143 (Singapore; description of specimens; synonymy; includes *regalis*).

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Comanthina schlegelii A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (*Actinometra schlegelii* P. H. Carpenter); p. 179 (synonymy; includes Carpenter's *dissimilis*, *duplex*, *nobilis*, and *regalis*; ?East Indies; redescription of the type; discussion); p. 180 (Amboina); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 248 (no locality; description); Die Fauna Sudwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (East Indian species, occurring south to Percy I.);

p. 443 (range on the east coast); p. 456 (may or may not retain cirri when adult); Memoirs Australian Mus., vol. 4, 1911, p. 717 (known to P. H. Carpenter from Australia); p. 721 (occurs south to Cape York); p. 733 (in key); p. 753 (annotated synonymy; characters; Australian record; range; discussion; includes *nobilis*, *regalis*, and *dissimilis*); Records of the Australian Mus., vol. 9, No. 1, 1912, p. 81 (Solomon Is.); Smiths. Miscel. Coll., vol. 60, No. 10, 1912, p. 6 (compared with *Comaster belli*); p. 8 (Mortlock I., Carolines [recorded by Hartlaub as *parvicirra*]; Cebu; Ekalin, St. Matthias I.); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 391 (Amboina); Crinoids of the Indian Ocean, 1912, p. 31 (=*Actinometra multifida* Bell, 1884, part); p. 36 (includes *duplex*, *nobilis*, *regalis*, and *schlegelii* P. H. Carpenter, 1888); p. 37 (=*Actinometra parvicirra*, part, and *regalis* Hartlaub, 1891); p. 38 (=*duplex* Bell, 1894); p. 39 (=*regalis* Döderlein, 1898); p. 40 (=*typica* Bell, 1902); p. 91 (synonymy; off Tobu I., 35 fathoms; southern part of Malacca Strait; Invisible Bank; summary of previous records; discussion); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1912, p. 308 (relation to *Comaster belli*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 14 (published references to specimens in the British Museum; localities in detail; characters of the specimens).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 82 (Aru Is.); p. 83 (Amboina); p. 88 (Amboina, Strubell; Aru Is., Merton; characters of the 2 specimens).—A. H. Clark, Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of the distribution in Australia); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 46 (synonymy; notes; stations 33, 99, 164, 220, 303; Batavia Bay); pp. 271–274, 276 (listed).

Diagnostic features.—The arms are 80–200 (usually 160–190) in number in well-developed individuals. This species is readily distinguished from *belli* by the absence of the high carinate processes found on the lower pinnule segments in that species. From all other comasterids with a large number of arms it is usually easily distinguished by the occurrence of IIIBr 2 series on the outer sides of each ray, and IIIBr 4 (3+4) series interiorly, as well as by a characteristically massive appearance due to the broadening and dorsal flattening of the division series and the solid interradial plating. *Comanthus trichoptera* and *C. pinguis* have much the same appearance, but in them the IIIBr series are all 4 (3+4), and neither occurs within the range of *schlegelii*.

Description.—The centrodorsal is pentagonal or more or less sharply stellate, its dorsal surface flush with, or slightly below, that of the radials.

There are typically no cirri in fully developed specimens. But in nearly half the examples seen there are 1, 2, or sometimes even more. When present the cirri are rather stout, of uniform width throughout their length, and consist of 15 segments of which the first two are about three times as broad as long, the third is about twice as broad as long, the fourth is nearly as long as broad, and those following are slightly longer than broad, after the seventh or eighth very gradually decreasing in length and becoming about twice as broad as long distally. The opposing spine is minute, subterminal or median. The terminal claw is long, slender, and moderately curved. Young individuals have the cirri X–XII, 15; the longer segments are slightly constricted centrally, and the shorter distal are slightly compressed laterally, appearing somewhat broader in lateral view.

The ends of the basal rays are usually just visible at the angles of the centrodorsal.

The radials are trapezoidal, proximally about half again and distally about two and one-half times as broad as long. The IBr_1 are about as long as the radials, and are in close apposition laterally. The IBr_2 (axillaries) are almost or quite triangular, twice as long as the IBr_1, two and one-half times as broad as long, in close lateral apposition. The IIBr series are normally 4 (3+4), but frequently 2 on 1 or 2 of the rays, though rarely on more than 2. The IIIBr series are 2 on the outer side of the IIBr series, 4 (3+4) on the inner, but become more or less irregular after IIBr series of 2 where there is a tendency to develop all the IIIBr series 4 (3+4). The IVBr, VBr, and VIBr series are 4 (3+4), exceptionally 2, the last frequently absent. One or more of the division series in each specimen is not rarely 6 (3+4, 5+6) or 6 (5+6). The IIBr series, like the IBr series, are very broad and only slightly convex dorsally, closely united interiorly, exteriorly united either directly or by a narrow V-shaped strip of strongly plated perisome. The further division series are closely connected exteriorly either directly or by a narrow strip of strongly plated perisome as far as the base of the IIIBr series, or sometimes as far as the $IIIBr_2$; interiorly this connection extends somewhat further out, and further still between the branches arising from a IIBr or subsequent axillary. After the distal limit of the connecting perisome the division series become more rounded dorsally and laterally, and entirely free laterally. The calyx and consolidated division series may lie almost in a single plane, or they may form a cup-shaped structure almost hemispherical in lateral view.

The 80–200 (usually 160–190) arms are from 90 to 150 mm. in length. They increase slightly in width to the twelfth or fourteenth brachial, from that point gradually tapering to the tip. The first 2 brachials are slightly wedge-shaped, twice as broad as long, the first entirely united and the second in apposition interiorly. The first syzygial pair (composed of brachials 3+4) is twice as broad as long to as long as broad. The next 2 brachials are oblong or slightly wedge-shaped, twice as broad as long, those following becoming triangular, about half again as broad as long, distally gradually wedge-shaped again but of the same length, and terminally slightly longer. From the sixth or seventh onward the brachials have rather prominently overlapping and finely spinous distal ends.

One or two of the posterior postradial series are sometimes, but not always, considerally smaller than the others, with shorter and more rapidly tapering arms. The posterior postradial series are usually ungrooved, no ambulacral grooves running to them from the disk. One or more of the arms upon the other postradial series are also ungrooved.

Syzygies occur between brachials 3+4, again from between brachials 10+11 to between brachials 18+19, and distally at intervals of from 3 to 7 (usually 4–6) muscular articulations.

The disk is from 30 to 50 mm. in diameter, naked or with a few scattered concretions. The mouth is marginal, radial, or interradial. The anal area is very large. The anal tube is central.

P_D is 32 mm. long, slightly stouter than the succeeding pinnules, tapering rather rapidly in the proximal fourth and then remaining practically uniform to the tip, with 65–70 segments all of which are broader than long. The basal segments are somewhat produced ventrally. The comb is composed of 8–11 very small rounded triangular teeth, all but the proximal 2 or 3 of which are ordinarily repeated on the inner side of the pinnule. The pinnule on the IIIBr series is similar, 27 mm. long. The pinnule on the IVBr series is similar, 15 mm. long. P_1 is 13 mm. long. P_2 is about 12 mm. long. The pinnules from P_D to P_2 become progressively more slender, P_2 being very delicate. P_3 is 8 mm. long with about 27 segments; it is about as stout as P_2, but the corners of the segments are more broadly cut away, and there is considerably more ventral perisome. The following pinnules are similar, but slightly stouter with a more serrate outline, the short segments with somewhat prominent and finely spinous distal ends. The terminal comb disappears at about P_5 or P_8, rarely extending to P_{20}. The distal pinnules are slender, about 7 mm. long, with about 18 segments, the longest of which are scarcely longer than broad. On postradial series where the IIBr series are 2 and P_D is therefore absent, P_P is 30 mm. long, resembling P_D as described, and the following pinnules decrease in size as given above.

Notes.—The specimen from Suvadiva is of enormous size.

Of the 2 specimens recorded by Dr. H. L. Clark from Ceylon 1 has about 120 arms. In the other, which I have personally examined, there are about 100 arms; all of the IIBr series are 4 (3+4); the centrodorsal is on a level with the dorsal surface of the radials.

The specimen from off Tobu Island is small with about 70 arms many of which are arising by multiplicative regeneration from broken IIBr series, showing that the individual is just passing into the adult stage. The arm division is perfectly regular, all the division series being 4 (3+4) except the exterior IIIBr series, which are 2. The dorsal perisome is plated. The centrodorsal is thin discoidal with a few rudimentary cirri and a single fully developed cirrus on the periphery; the last is 10 mm. long and consists of 14 segments.

The specimen from Invisible Bank has about 120 arms which are 130 mm. long.

One of the examples from Singapore has nearly 100 arms which are 100 mm. in length. There are no cirri, but the centrodorsal is slightly raised above the surface of the radials. The interspaces between the division series and lower pinnules where they are not in apposition are occupied by large irregular plates which, however, are not so evident as in larger and more developed individuals from the Philippines.

The other specimen from Singapore is young, with 37 very attenuate arms 150 mm. long.

The specimen from the southern portion of the Malacca Straits has about 140 arms. It is slightly smaller and has slightly fewer arms than the average from the Philippines. The centrodorsal is rounded pentagonal, flush with the dorsal surface of the radial ring, and bears a single cirrus which is 13 mm. in length and is composed of 14 segments. The interradial areas are covered with a uniform fine calcareous deposit which is not broken up into interradial plates. The synarthrial tubercles are rather prominent. The dorsal surface of the animal as a whole is nearly flat.

In the specimen from Billiton as described by Koehler there are no cirri, but the remnants of cirrus sockets are still present on the periphery of the centrodorsal.

One of the specimens from the Danish expedition to the Kei Islands station 67 has about 120 arms. The 10 IIBr series are all 4 (3+4). The outer IIIBr series are 2 and the inner 4 (3+4) on all the postradial series. The centrodorsal is somewhat irregularly pentagonal and is not quite sunken to the level of the radial circlet; it bears a few minute cirrus stumps. The interbrachial perisome is narrow and completely plated. The other specimen is medium sized with about 85 arms. Of the

10 IIBr series 9 are 4 (3+4) and 1 is 2. The IIIBr series are 2 externally and 4 (3+4) internally except on a single postradial series where all 4 IIIBr series are 4 (3+4); it is this ray that bears a IIBr 2 series. The IIBr series are very broad and are but slightly convex dorsally; they are almost in contact laterally, the narrow intervening spaces being heavily plated. The centrodorsal is pentagonal with the corners slightly produced, and is slightly raised above the surface of the radial ring. There are a few small pits in the interradial areas of the margin.

The specimen from Batavia Bay has about 70 arms which are 85 mm. long. The division series are comparatively narrow and well separated dorsally. The dorsal interradial perisome is heavily plated. The cirri are XIV, 14–16, from 10 to 12 mm. long, with others more or less rudimentary. The color in alcohol is slaty gray.

Both of the specimens from *Siboga* station 33 are large and typical of the species. In one the centrodorsal is regularly pentagonal, though as yet it has not quite sunken to the level of the radial pentagon. The IIBr series on the 2 posterior rays are 2, and on the other 3 rays 4 (3+4). On 1 of the 2 posterior rays the IIIBr series are 4 (3+4) — 2 — 4 (3+4) — 4 (3+4), and on the other they are all 4 (3+4). On 1 of the other rays 1 of the external IIIBr series is 2, the other 3 IIIBr series being 4 (3+4). On the other 2 rays the IIIBr series are typical. The division series are very broad, and are almost or quite in lateral apposition. Wherever it is exposed the dorsal interradial perisome is heavily plated. The 3 anterior rays are dark brown with small blotches of yellowish. The 2 posterior rays and the bases of the arms which they bear are yellowish white, but the outer part of these arms is dark brown like those on the anterior rays with more or less light yellow in the median line. The other specimen is typical.

The specimen from *Siboga* station 303 is a magnificent fully grown example, but its centrodorsal bears VIII more or less rudimentary cirri.

The example from *Siboga* station 99 is large with about 120 arms which are about 130 mm. long. The centrodorsal is small and pentagonal, sunk to the level of the radial circlet.

The larger individual from *Siboga* station 220 has 70 arms 120 mm. long. The centrodorsal is very thin, discoidal, with the flat dorsal pole 3.5 mm. in diameter. The cirri are XIV, 14–15, 10 mm. long. The color is whitish, the division series heavily blotched with dark gray; the distal portion of the arms is dark gray, and the outer part of the pinnules is brown.

In the smaller example from *Siboga* station 220 there are 62 arms 95 mm. long. It closely resembles the specimen from Batavia Bay. There is usually one more division series on the outermost branch of the IIIBr series than elsewhere. The arms are less developed and more slender than in the preceding, and the division series are less broad. The centrodorsal is thin discoidal, with the bare dorsal pole 3 mm. in diameter. The cirri are XI, 14–15, from 10 to 12 mm. long, with in addition some which are more or less rudimentary.

In the specimen from the ?East Indies, which is the type of *Actinometra schlegelii*, as described by Carpenter, the centrodorsal is a thin circular disk hollowed in the center and bearing about 20 marginal cirrus sockets.

The cirri are lost.

The radials are almost entirely concealed except for their angles which are rounded, thickened, and turned upward so as to rise somewhat dorsally above the level of the rest of the calyx. Their distal edges are incurved to receive the convex proximal edges of the trapezoidal IBr_1, which are closely united laterally. The IBr_2 (axillaries) are short, barely half as long again as the IBr_1, widely triangular, and in contact laterally. The postradial series divide six times, all of the division series beyond the IBr series being 4 (3+4). The division series are somewhat closely united by plated perisome as far as the IIIBr axillaries, and the apposed sides of contiguous ossicles are flattened laterally. The first segments after each axillary are closely united laterally, and the second are but little separated.

There are more than 80 arms which are probably about 125 mm. in length. The first two brachials are broad and about equal in length, the second being the more wedge-shaped. The next 2 or 3 brachials are roughly oblong and those following are broad, wedge-shaped, with much raised and strongly overlapping distal edges. The anterior arms are long and slowly tapering and are composed of 150+ brachials which remain wedge-shaped until quite near the end, the later ones being relatively shorter, blunter, and smoother, and the terminal squarer, elongating just at the end. The posterior arms taper much more rapidly and end after about 120 brachials, those of the distal third being bluntly wedge-shaped and the terminal squarer.

The first syzygy is between brachials 3+4. The second is from between brachials 10+11 to between brachials 14+15, usually between brachials 11+12 or 12+13. The distal intersyzygial interval is from 2 to 6, usually 4, muscular articulations.

The second elements of all the division series beyond the first have long and fairly stout pinnules which decrease rather rapidly to that on the fourth brachial (P_2) which is not, however, especially short or slender. The pinnules following are considerably stouter and gradually increase in length but decrease in stoutness after about the twenty-fifth brachial. The terminal pinnules are slender but not unusually long, especially in the posterior arms. The large basal segments of the stout lower pinnules slightly overlap one another, and the lowest pinnules have a moderate terminal comb which disappears after about the eighth brachial.

The disk is missing. There are several ungrooved arms. The width across the radials is 14 mm.

I examined this specimen at the Leyden Museum in 1910. It proved to be a typical example of the form described in the *Challenger* report under the names *Actinometra duplex*, *Actinometra nobilis*, and *Actinometra regalis*, and also mentioned by Carpenter in 1884 as *Actinometra dissimilis*. The specimen appears to have had IV cirri, of which the first 2 segments still remain. There are numerous more or less obsolete cirrus sockets. Of the IIIBr series those on 2 rays have the typical arrangement, 2 externally and 4 (3+4) internally. On a third ray 1 of the external IIIBr series is 2, but the other 3 are 4 (3+4). On the remaining 2 rays all the IIIBr series are 4 (3+4). The other division series are 4 (3+4) as usual.

At the time of Carpenter's visit to Leyden he had not discovered the significance of the curious variation in the IIIBr series, but simply considered division series of 2 replacing those of 4 (3+4) as abnormal. From his notes, therefore, he could not see that his *schlegelii* was the same thing as the *nobilis* of the *Challenger* report.

The specimen from Bassett-Smith Bank is small, with a remarkable development of interradial plating.

As described by Carpenter, the specimen from Banda which served as the type of *Actinometra duplex* has the centrodorsal a rounded and slightly convex disk, bearing marginal cirri.

The cirri are about XV, 14–17. The cirrus segments are tolerably uniform.

The radials are visible. The IBr_1 are partly united laterally. The IBr series are quite free laterally. The IIBr series are 4 (3+4). The IIIBr series, when present, are 2 externally, but 4 (3+4) internally. All the succeeding division series are 4 (3+4). IVBr series, and rarely VBr series, are present.

There are 45 arms 105 mm. long. The anterior arms consist of 120 slightly overlapping triangular brachials which gradually become quadrate. The posterior arms are shorter, with only half as many brachials.

Syzygies occur between brachials 3+4, 13+14, and 18+19, and distally at intervals of 4 muscular articulations.

P_D is relatively long and stout, reaching 13 mm., and that on the IVBr series, which is but little smaller, is nearly twice the length of P_1. The pinnules on the next 3 brachials are still smaller, after which the size again increases, though the terminal pinnules are not especially long. The first few pinnules have a well-marked comb which becomes gradually weaker and is lost after the tenth brachial.

The disk is naked, 15 mm. in diameter. The mouth is interradial. Some of the hinder arms have very faint grooves, and others none at all.

Carpenter said that the great difference in length between the anterior and posterior arms of this specimen is very striking, the more so as most of the hinder arms have grooves, though only faint ones. The 5 hinder arms of the left anterior ray are, however, altogether devoid of ambulacra, as the groove which should supply them suddenly stops quite short on the disk at the base of the IIBr series. The right or western curve of the horseshoe passes by them altogether on its way to the left posterior ray.

Carpenter noted that in this specimen IVBr series occur on all the rays but one, and in the anterior half of the ray regeneration has taken place to such an extent that there is a VIBr series. He considered this as probably not the normal condition.

I examined this specimen in the British Museum and found it to be a quite typical young individual.

The 2 small specimens from Banda which served as the types of *Actinometra regalis* were thus described by Carpenter. The centrodorsal is a rudely circular disk much hollowed in the center and bearing marginal cirri.

The cirri are XV–XX, 15. The cirrus segments are nearly equal, and the penultimate bears no opposing spine.

The radials are visible. The IBr_1 are closely united laterally. The IBr_2 (axillaries) are short, widely triangular, and in contact laterally. The rays may divide five times but do not spread much, as the first ossicles beyond each division are closely united laterally. The division series are united by interradial plating to the level of the IIBr axillaries or slightly beyond it. All of the division series beyond the IBr series are 4 (3+4).

The arms are very numerous, from 13 to 24 on each ray, and are 110 mm. in length. They are composed of moderately long, triangular, and much overlapping brachials which soon become wedge-shaped and are nearly square at the ends. The anterior arms have 160 and the posterior only 60 or 70 segments.

Syzygies occur between brachials 3+4 and 11+12 or 13+14, and distally at intervals of from 3 to 7, usually 4 or 5, muscular articulations.

P_D and P_P are of about equal size, reaching 15 mm. in length. The length of the pinnules following diminishes to P_1, which is considerably shorter, while P_2 and P_b are much more so, after which the length increases again. The later pinnules on the anterior arms are not especially long. Terminal combs occur as far as the tenth brachial.

The disk is 27 mm. in diameter, naked or slightly plated. The mouth is interradial or nearly so.

The color in alcohol is deep brown, the pinnules tipped with yellow green.

I found one of these specimens to have the cirri VIII, 15–17; the other has 4 large and 2 small cirri, and a few cirrus stumps.

Carpenter's figure of this species (*regalis*) does not wholly accord with his description. The IIIBr series on the 5 rays are shown as follows:

2—4 (3+4)—4 (3+4)—2.
2—4 (3+4)—4 (3+4)—2.
4 (3+4)—2—4 (3+4)—2.
2—4 (3+4)—2—4 (3+4).
4 (3+4)—4 (3+4)—2—4 (3+4).

Of the 10 IIBr series 6 bear IIIBr series showing the normal arrangement, the external being 2 and the internal 4 (3+4). On the last ray given both of the IIBr series are 2 instead of 4 (3+4); the IIIBr series to the right show the normal reversed arrangement which follows IIBr 2 series. Two other pairs of IIIBr series show a reversed arrangement. In only a single case are the 2 IIIBr series following a IIBr series both 4 (3+4).

The specimen from the Danish expedition to the Kei Islands station 20 is small, with 69 arms 120 mm. long. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. The IIIBr series on the various rays are as follows:

2—2—4 (3+4)—4 (3+4).
2—4 (3+4)—4 (3+4)—2.
4 (3+4)—4 (3+4)—4 (3+4)—4 (3+4).
4 (3+4)—4 (3+4)—4 (3+4)—4 (3+4).
4 (3+4)—0—4 (3+4)—2.

One of the specimens from station 30 is rather small with 70 arms 140 mm. long. Only a single postradial series shows the typical arrangement of IIIBr series, 2 externally and 4 (3+4) internally; on the other 4 a single outer IIIBr series is 2, the other 3 being 4 (3+4). Of the 10 IIBr series 8 are 4 (3+4) and 2 are 2. The centrodorsal is pentagonal with the dorsal surface almost down to the level of the dorsal surface of the radial circlet; its periphery bears a few minute cirrus buds. The other specimen from station 30 is very young with about 55 arms 120 mm. long.

The specimen from station 37 has about 120 arms 160 mm. long. There are 10 IIBr 4 (3+4) series. The IIIBr series are 2 exteriorly and 4 (3+4) interiorly on all the postradial series.

The specimen from station 43 is very young with 34 arms about 60 mm. long. Of the 10 IIBr series 5 are 4 (3+4) and 5 are 2. The IIIBr series are 2 exteriorly and 4 (3+4) interiorly on all the postradial series. The interradial perisomic areas are completely and heavily plated. The cirri are XII, 13–14, about 10 mm. long.

One of the specimens collected by the Danish expedition to the Kei Islands at Amboina has about 100 arms. One of the postradial series has the 2 IIBr series 2 and all 4 IIIBr series 4 (3+4). On the other 4 postradial series the IIBr series are 4 (3+4); on 3 of these the IIIBr series are 2 exteriorly and 4 (3+4) interiorly; on the fourth 1 of the exterior IIIBr series is 4 (3+4), the other being 2. The cirri are V, 16–17, from 13 to 15 mm. long. Another specimen is small, though well developed, with about 80 arms 130 mm. long. The 10 IIBr series are 4 (3+4). On 4 of the postradial series the IIIBr series are 2 exteriorly and 4 (3+4) interiorly. On the fifth postradial series one of the exterior IIIBr series is 2, the other 3 IIIBr series being 4 (3+4). A third specimen is similar to the first, but has only II cirri.

Dr. Clemens Hartlaub recorded (as *regalis*) 17 specimens from Amboina which he thus described:

The centrodorsal is approximately circular or pentagonal, usually flat, sometimes scarcely rising above the surface of the radial pentagon. The cirri are marginal.

The cirri are VI–XX, about 17. The fifth, sixth, and seventh segments are the longest. The segments are as a rule smooth, but the outermost may bear slight spines. The opposing spine is small or entirely lacking. The distal end of the cirri is commonly thicker than the proximal.

The radials are visible. The IBr_1 are trapezoidal. The IBr_2 (axillaries) are broadly triangular. The rays may divide six times, but the rule is five times. The IIBr series are 4 (3+4). The 2 first elements of the IIBr series on adjacent rays are sometimes in close contact, but often separated by a broad interradial plating. This may even reach downward to the centrodorsal, separating the outer halves of 2 adjacent radials. A similar, but narrower, plating is usually found between the 2 IIBr series on each ray, uniting their 2 distal elements, and sometimes also between the first elements of the inner IIIBr series. The 2 branches arising from each axillary diverge only very slightly so that the first and often also the second ossicles of adjacent division series are in contact. The IIIBr series are as a rule 2 externally and 4 (3+4) internally. All the following division series are 4 (3+4).

There are usually more than 100 arms, and at least 70. The anterior arms are long, up to 160 mm. in length, and taper slowly. The posterior arms are much shorter and taper rapidly. The brachials are moderately short, and those in the proximal half of the arms have strongly produced distal ends. The first brachials are usually closely united interiorly. After about the sixth the brachials become triangular and strongly overlapping, then fairly soon short wedge-shaped and finally more oblong.

The first brachial syzygy is between brachials 3+4, and the second from between brachials 6+7 to between brachials 18+19, usually from between brachials

11+12 to between brachials 14+15. The distal intersyzygial interval is from 2 to 7, but usually 4, muscular articulations.

P_D may reach 25 mm. in length, but is usually between 15 and 20 mm. The next, whether on the IIIBr or IVBr series, is slightly shorter. The following pinnule is only half as long, and P_1 is always much shorter than those preceding. P_2 and P_b are the shortest pair. The distal pinnules reach about 8 mm., and become much shorter toward the tip of the posterior arms. The comb on the proximal pinnules is sometimes only represented by a trace. It occurs as far as the pinnule of the tenth brachial.

The disk is 35 mm. in diameter, either naked or somewhat plated. The mouth is interradial.

The color in alcohol is light yellowish green, grayish brown, or dark brown.

The expanse is 300 mm. This would mean an arm length of 150 mm.

Hartlaub remarked that it is only rarely that all of the rays in any given specimen show the typical arrangement of the IIIBr series—2 externally and 4 (3+4) internally. This occurred in only 3 out of his 17 specimens. Usually on 1 or 2 rays the IIIBr 2 and IIIBr 4 (3+4) series are irregularly arranged, and in 1 specimen only a single ray shows the typical arrangement. But rays on which the 4 IIIBr series have the same number of elements are very rare. It is noteworthy that in specimens with an irregular arrangement of the IIIBr series the IIBr series are also irregular, being 2 instead of 4 (3+4). Hartlaub says that such abnormal IIBr series are always followed by an abnormal arrangement of the succeeding IIIBr series.

I have examined 2 of Doctor Hartlaub's specimens, 1 in the Berlin and 1 in the Leyden Museum, but have nothing to add to his account.

According to Reichensperger, the specimen collected by Professor Strubell at Amboina is a robust example with 145 arms which are up to 145 mm. in length. The centrodorsal is a rather thin pentagonal disk slightly sunken in the center. The cirri are III, 14–15, 13 mm. long; there are traces of a few more rudimentary cirri. All of the IIBr series are 4 (3+4). The IIIBr series for the most part are 4 (3+4). The disk is 35 mm. in diameter. The mouth is interradial. P_D is up to 25 mm. long. The combs are poorly developed. The color in alcohol is red brown.

Professor Döderlein's specimen from Amboina has the cirri XIV, 15–16. A few of the IIBr and IIIBr series are 2 instead of 4 (3+4). The color is dark violet with the outer half of the arms whitish.

The magnificent specimen from *Siboga* station 164 has about 100 arms which are about 150 mm. long. The division series are broad, interiorly united and closely flattened against each other. The division series on adjacent rays are closely flattened against each other as far as the $IIBr_2$, or even the IIBr axillary, beyond which point the perisome is solidly plated. On 3 of the rays the IIIBr series show the normal arrangement, being 2—4 (3+4)—4 (3+4)—2. On one ray the IIIBr series are 2—4 (3+4)—4 (3+4)—4 (3+4), and on the fifth they are 2—2—4 (3+4)—4 (3+4). The centrodorsal is very small, concave dorsally, and sunken within the radial ring.

The specimen from the Aru Islands as described by Reichensperger is unusually stout, with 151 arms which are up to 140 mm. long. With the exception of the outer IIIBr series on 3 rays, which are 2, all the division series are 4 (3+4). The centrodorsal is small, markedly stellate, without any trace of cirri or of cirrus sockets. The disk is over 35 mm. in diameter. The mouth is interradial.

The specimen from the Percy Islands, Queensland, has 63 arms which are from 85 to 90 mm. long. A single cirrus with 15 segments remains. The interradial dorsal perisomic plating is very heavy, the plates being exceptionally thick and convex dorsally. The 5 lowermost plates stand out large and prominent in the interradial angles, being especially convex dorsally.

The specimen from New Britain has XIII stout cirri about the edge of the centrodorsal.

The example from St. Matthias Island is small, but without cirri.

The specimen from the Solomon Islands is large.

The specimen from Mortlock Island is small but typical. It has 52 arms which are about 85 mm. long. On 4 of the rays the IIIBr series are 2 externally and 4 (3+4) internally. On the fifth ray one of the external IIIBr series is 4 (3+4) instead of 2. The cirri are VIII, 13–14.

The specimens from *Albatross* stations 5249 and 5250 and one of those from station 5254 have each 2 well-developed cirri.

Carpenter said that the specimen from *Challenger* station 208, which is the type of his *Actinometra nobilis*, is more uniformly colored than the 5 from Zamboanga and has a much larger terminal comb, which extends to the fortieth brachial instead of ceasing at about the tenth as in the Zamboanga form. I did not see this specimen at the British Museum.

The 5 specimens from Zamboanga were originally considered by Carpenter as representing a distinct species, which he mentioned in 1884 as *Actinometra dissimilis*, but in 1888 he incorporated their characters in his description of *Actinometra nobilis*.

Of this form he says that the centrodorsal is a thin disk, in the adult more or less stellate and rather below the level of the radial pentagon, in immature individuals with about X marginal cirri.

The 2 elements of the IBr series are short and are closely united laterally. The rays may divide five times. The IIBr series are 4 (3+4). The IIIBr series are 2 exteriorly and 4 (3+4) interiorly. The IVBr and VBr series are 4 (3+4). The first 2 elements of the IIBr series of each ray are closely united laterally; those of adjacent rays are sometimes united all around the calyx, and sometimes separated by a strong interradial plating which extends to about the level of the IIIBr axillaries.

The 80–100 arms are 150 mm. in length. The anterior arms are long and slowly tapering and are composed of from 150 to 200 slightly overlapping brachials which remain almost triangular until near the end. The posterior arms taper rapidly and are composed of from 80 to 100 or more quadrate brachials.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 18+19, and distally at intervals of from 4 to 6 muscular articulations.

P_D is moderately stout, reaching 30 mm. in length. Those on the succeeding division series gradually decrease in size, but P_1 is only half as long as its predecessor, and the next 2 pairs of pinnules are not much smaller. The terminal pinnules are much longer in the anterior than in the posterior arms. The terminal comb of the lower pinnules is variable, being sometimes small and ceasing at about the tenth brachial, and sometimes much larger, extending out to the fortieth brachial.

The disk is 50 mm. in diameter. The mouth is interradial. The ventral surface of the disk is usually naked, except for a little plating around the peristome. The posterior arms are mostly without ambulacral grooves, and in one case, at least, there are ungrooved arms on each ray.

The color in alcohol is dull green, either alone or mottled with purple, brown, and white.

I examined these specimens in London and found them to be quite like others in the *Albatross* Philippine collection.

The specimen from Palawan is a magnificent example, with about 100 arms 155 mm. long. Seven large functional cirri 13 mm. in length remain, all on the anterior semicircumference of the centrodrosal.

The specimen from Cebu is typical. There is a single cirrus remaining.

Of the specimens from Port Galera, Mindoro, one has about 140 arms 200 mm. long. Another also has the arms 200 mm. in length. In one of the specimens 3 of the IIBr series are 2, and of the 20 IIIBr series 11 are 2 and 9 are 4 (3+4); the arrangement of these last is not typical.

In the specimen from the Macclesfield Bank the centrodorsal bears the stumps of a row of cirri.

The specimen without locality in the Paris Museum is small but typical; there are no cirri.

Localities.—Suvadiva, Maldives [Bell, 1902; A. H. Clark, 1912, 1913] (1, B. M.).

Ceylon [H. L. Clark, 1915] (1, M. C. Z., 602).

Investigator; off Tobu Island; 64 meters [A. H. Clark, 1912] (1, U.S.N.M., 35122).

Investigator; Invisible Bank, Andaman Islands (lat. 11° 29′ to 10° 59′ N., long. 93° 30′ E.) [A. H. Clark, 1912] (1, U.S.N.M., 35119).

Malacca [A. H. Clark, 1912, 1913] (1, B. M.).

Singapore; Svend Gad [A. H. Clark, 1909, 1912] (2, C. M.).

Investigator; southern portion of Malacca Straits [A. H. Clark, 1912] (1, I M.).

Billiton, Sunda Islands [Koehler, 1895; A. H. Clark, 1912].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 67; Java Sea, north of western Java (lat. 5° 48′ S., long. 106° 12′ E.); 38 meters; sand; July 27, 1922 (2). Pl. 55, fig. 161.

Siboga; Batavia Bay, Java [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 33; Bay of Pidjot, Lombok; 22 meters and less; mud, coral and coral sand; March 24–26, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 303; Haingsisi, Samau Island; down to 36 meters; lithothamnion; February 2–5, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 99; anchorage off North Ubian; 16–23 meters; lithothamnion bottom; June 28–30, 1899; June 28 and 29 to the west and June 30 to the east of the island [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 220; anchorage off Pasir Pandjang, west coast of Binongka, southeast of Celebes; 278 meters; coral sand; November 1–3, 1899 [A. H. Clark, 1918] (2, U.S.N.M., E. 466; Amsterdam Mus.).

?East Indies [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911].

Bassett-Smith Bank; 16 meters [A. H. Clark, 1913] (1, B. M.).

Challenger; Banda [P. H. Carpenter, 1881, 1882] (3, B. M.). Same, 31 meters [P. H. Carpenter, 1888; A. H. Clark, 1912].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 20; 50 meters; sand and shells; April 14, 1922 (1); station 30; about 40 meters; sand and shells; April 18, 1922 (2); pl. 55, fig. 160; station 37; about 40 meters; sand; April 23, 1922 (1); station 43; about 35 meters; sand and coral; April 27, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Toeal; about 2 meters; sand and coral; March 26, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; about 2 meters; stony bottom; February 9, 1922 (4).

Amboina; Dr. J. Brock [Hartlaub, 1891; A. H. Clark, 1911, 1912] (1, L. M.). Same [Döderlein, 1898; A. H. Clark, 1912]. Same; Professor Strubell [Reichensperger, 1913].

Bay of Amboina [Koehler, 1895; A. H. Clark, 1912].

Siboga station 164; off Waigeu, northwest of New Guinea (lat. 1° 42′ 30″ S.; long. 130° 47′ 30″ E.); 32 meters; sand, small stones, and shells; August 20, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Aru Islands; Dobo Strait; 16 meters; coarse shell sand; Dr. H. Merton, March 20, 1908 [Reichensperger, 1913].

Alert; Percy Islands, Queensland (lat. 21° 40′ S.) [Bell, 1884; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Blanche Bay, New Britain; Dr. Arthur Willey [A. H. Clark, 1912, 1913] (1, B. M.).

Ekalin, St. Matthias Island, Bismarck Archipelago; reef; Dr. G. Duncker [A. H. Clark, 1912] (1, H. M.).

Solomon Islands; H. M. S. *Penguin* [A. H. Clark, 1912, 1913] (1, B. M.).

Mortlock Island, Carolines; Captain Pohl [Hartlaub, 1891; A. H. Clark, 1912] (1, H. M.). Pl. 64, fig. 180.

Albatross station 5165; Tawi Tawi group, Jolo (Sulu) Archipelago; Observation Island bearing N. 70° W., 6.4 miles distant (lat. 4° 58′ 20″ N., long. 119° 50′ 30″ E.); 16 meters; coral; February 24, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 35127, 35129).

Albatross station 5163; Tawi Tawi group, Jolo Archipelago; Observation Island bearing N. 79° W., 6.7 miles distant (lat. 4° 59′ 10″ N., long. 119° 51′ 00″ E.); 51 meters; coral sand; February 24, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35120).

Albatross station 5147; in the vicinity of Siasi, Jolo Archipelago; Sulade Island (E). bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908] (4, U.S.N.M., 35112, 35116).

Albatross station 5146; in the vicinity of Siasi, Jolo Archipelago; Sulade Island (E.) bearing N. 18° W., 3.4 miles distant (lat. 5° 46′ 40″ N., long. 120° 48′ 50″ E.); 24 meters; coral sand and shells; February 16, 1908 [A. H. Clark. 1908] (1,U.S.N.M., 35126).

Albatross station 5145; in the vicinity of Jolo; Jolo Light bearing S. 16° E., 0.85 mile distant (lat. 6° 04′ 30″ N., long. 120° 59′ 30″ E.); 42 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35125). Pl. 53, fig. 158.

Albatross station 5138; in the vicinity of Jolo; Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 35 meters; sand and coral; February 14, 1908 [A. H. Clark, 1908].

Albatross station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908 (2, U.S.N.M., 35159).

Albatross station 5252; Gulf of Davao; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35124).

Albatross station 5253; Gulf of Davao; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 35114, 35117). Pl. 54, fig. 159.

Albatross station 5250; Gulf of Davao; Linao Point bearing N. 22° E., 1.1 miles distant (lat. 7° 05′ 07″ N., long. 125° 39′ 45″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35121).

Albatross station 5254; Gulf of Davao; Linao Point bearing N. 44° E., 0.7 mile distant (lat. 7° 05′ 42″ N., long. 125° 39′ 42″ E.); 38 meters; sand and coral; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35123).

Albatross station 5249; Gulf of Davao; Lanang Point bearing N., 1 mile distant (lat. 7° 06′ 06″ N., long. 125° 40′ 08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35115).

Challenger station 208; southeast of Basilan, Philippines (lat. 11° 37′ N., long. 123° 31′ E.); 33 meters; blue mud; January 17, 1875 [P. H. Carpenter, 1888].

Challenger; Zamboanga, on the southwestern tip of Mindanao [von Graff, 1887; P. H. Carpenter, 1884, 1888; A. H. Clark, 1912, 1913] (5, B. M.)

Albatross; Ulugan Bay, Palawan; December 29, 1908 [A. H. Clark, 1911] (1, U.S.N.M., 35128).

Cebu, Philippines; Captain Ringe [A. H. Clark, 1912] (1, H. M.).

Port Galera, Mindoro, Philippines; Dr. L. E. Griffin [H. L. Clark, 1921] (12, M. C. Z., 619, 620, 677, 678).

Albatross; Santa Cruz Harbor, Marinduque, Philippines; shore; collected with dynamite; April 23, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35202).

Philippines [A. H. Clark, 1912, 1913] (1, B. M.)

Macclesfield Bank; 24 meters [Bell, 1894; A. H. Clark, 1912, 1913] (1, B. M.).

No locality; M. Leguillou [A. H. Clark, 1911] (1, P. M.). Same [A. H. Clark, 1913] (1, B. M.)

Geographical range.—From the Maldive Islands and Ceylon to northern Australia, the Solomon Islands, the Carolines, the Philippines, and Macclesfield Bank.

Bathymetrical range.—Littoral and sublittoral, occurring from the shore line down to 278 meters; but there is only a single record greater than 64 meters. The average of 23 definite depth records is 40 meters; omitting the record of 278 meters, the average is 30 meters. But the species is probably commonest in shallower water.

History.—This species was first mentioned in 1879 by P. H. Carpenter under the name of *Actinometra novae-guineae* as having been secured by the *Challenger* at Banda. On examining the type of *novae-guineae* in the Leyden Museum he discovered his mistake, and in 1881 he noted that the *Challenger* specimen from Banda was not *novae-guineae*, though he did not further identify it.

In 1879 Carpenter published a diagram showing schematically the distribution of the ambulacra on the disk in a new species of *Actinometra* from the Philippines which had been collected by the *Challenger*. The mouth is radial and submarginal, the anal tube is central, and the ambulacral groove to the right of the anal area is much reduced. Carpenter does not mention this diagram again. The specimen from which it was drawn is the one which was later described as *Actinometra nobilis*.

In 1881 he described a remarkably fine comasterid which he had found in the Leyden Museum labeled, with a query, as having come from the East Indies, under the name of *Actinometra schlegelii*. He gave the division series as being all 4 (3+4) and said that the species had as its specially distinctive character the peculiarity presented by the radials, which are flush with the IBr_1 along the middle line, but are thickened and turned upward at the angles, which appear as 5 small tubercles around the edge of the centrodorsal. He compared this new species only with *Comanthus bennetti*.

In 1884 in his report upon the stalked crinoids of the *Challenger* expedition Carpenter discussed *Actinometra schlegelii* at considerable length, and also 2 undescribed forms, *Actinometra nobilis* and *Actinometra dissimilis*, of both of which he gave specific formulas in footnotes.

The specimen of *Actinometra multifida* recorded by Bell in 1884 from the Percy Islands was in reality this species.

In 1887 Prof. Ludwig von Graff described some myzostomes sent him by Carpenter which had been taken from specimens from Zamboanga determined as *Actinometra nobilis*.

In 1888 Carpenter described and figured *Actinometra nobilis*, *Actinometra duplex* and *Actinometra regalis*. All of these he assigned to his *Parvicirra* group. *Actinometra duplex* and *Act. nobilis* he placed side by side in the key to the species of this group as being distinguished by having the IIIBr series 2 externally and 4 (3+4) internally. They were distinguished from each other by *nobilis* having no functional cirri and the rays closely united, while in *duplex* there are XV cirri and the rays are free. He placed *Actinometra regalis* and *Act. schlegelii* under the heading including species with all the IIIBr series 4 (3+4). They were placed side by side; *regalis* was said to have the radials largely visible, the brachials of moderate length, and the pinnules on the fourth and fifth brachials short, while in *schlegelii* the radials are mostly concealed, the brachials are short, and the pinnules on the fourth and fifth brachials are not especially short. *Actinometra dissimilis* was mentioned only in the remarks under *Actinometra nobilis*. Carpenter said that the name referred to the 5 specimens from Zamboanga which in 1884 he considered specifically distinct from the specimen from *Challenger* station 208, on which he seems originally to have based the name *nobilis*. From the records which he gives it is evident that the *novae-guineae* which he mentioned in 1879 and 1881 was the type of *Actinometra duplex*.

Dr. Clemens Hartlaub in 1891 recorded (as *regalis*) 17 specimens from Amboina which had been collected by Dr. J. Brock. The specimen from Mortlock Island which he recorded as *parvicirra* also proves to belong to this species.

In 1894 Bell recorded a specimen, as *Actinometra duplex*, from the Macclesfield Bank. In 1895 Prof. René Koehler recorded this species (as *regalis*) from the Sunda Islands and in another paper also from Amboina, and in 1898 Prof. Ludwig Döderlein again recorded it (as *regalis*) from Amboina.

In 1902 Bell recorded (as *Actinometra typica*) a specimen from the Maldives which had been collected by Prof. J. Stanley Gardiner.

In 1908 I recorded this species as *Comanthus nobilis* from 6 localities in the Philippines and as *Comanthus duplex* from another. In 1909 I listed it as *C. nobilis* from 4 more Philippine localities and as *C. duplex* from a fifth. In another paper published in the same year I recorded it from Singapore.

After an examination of the type of Carpenter's *Actinometra schlegelii* at Leyden and of his *duplex*, *nobilis*, and *regalis* in the British Museum, I published in 1911 notes showing that the Leyden specimen had been misinterpreted on account of the inaccuracy of the original description, and also notes on the type specimen of *regalis*, calling attention to the fact that it also had been erroneously described, as is easily seen by a comparison between the original description and the figure. *Actinometra dissimilis*, *Act. duplex*, *Actinometra nobilis*, and *Act. regalis* were all shown to be synonyms of the earlier *Actinometra schlegelii*.

In another paper published in the same year I recorded and gave notes upon a specimen without locality in the Paris Museum.

In a monograph on the crinoids of Australia published in 1911 the synonymy just indicated is included, and a complete account of the species, so far as the coasts of Australia are concerned, is given. Bell's record of *Actinometra multifida* from the Percy Islands is here corrected.

In a monograph on the crinoids of the Indian Ocean published in 1912 the revised synonymy is given, all of the records from the Indian Ocean are corrected on the basis of a study of the specimens in the British Museum, and the species is recorded from 3 new localities.

In a paper on the crinoids of the Hamburg Museum published in 1912 I assigned Hartlaub's specimen of *parvicirra* from Mortlock Island to this species, and also recorded it from 2 additional localities. In another paper on the crinoids of the Berlin Museum published in the same year I gave notes on one of the specimens from Amboina collected by Brock which had already been described by Hartlaub. In a paper on the crinoids of the Solomon Islands, also published in 1912, I recorded this form from that region on the basis of a specimen collected by the *Penguin* which I had seen in the British Museum.

In 1913 I published notes on all the specimens of this species in the British Museum, and in the same year Dr. August Reichensperger recorded it from the Aru Islands and from Amboina, giving notes on his specimens.

In 1915 Dr. H. L. Clark recorded 2 specimens from Ceylon and in another paper mentioned 3 from Torres Strait. These last, however, are really *belli*.

In 1918 I recorded this species from 6 additional localities in the East Indies, where it had been collected by the *Siboga*, and gave notes on the specimens.

Genus COMANTHERIA A. H. Clark

Actinometra (part) P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 208, and following authors.

Antedon (part) Bell, Proc. Zool. Soc. London, 1882, p. 534.

Comaster (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686.

Phanogenia (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124.

Comanthus (part) A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 206.

Comantheria A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (diagnosis; genotype *Antedon briareus* Bell, 1884); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 733 (in key; key to the Australian species); p. 751 (original reference; characters; range); Crinoids of the Indian Ocean, 1912, p. 11 (absent from the west coast of the Malay Peninsula and from farther west); pp. 55, 56 (in key); p. 89 (original reference; type); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetrical disk); p. 540 (1 or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 34 (in key; range); p. 42 (key to the included species).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 52 (pinnule combs); p. 56 (discussion); Zool. Bidrag från Uppsala, vol. 9, 1924, p. 74 (syzygies); p. 117 (relation to fossils).

Comanthus (*Comantheria*) A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 535.

Diagnosis.—A genus of Comasterinae in which the elements of the IBr series and the first 2 ossicles following each axillary are united by synarthry; most of the axillaries bear either 2 division series or 2 undivided arms; the IIBr series are all, or at least mostly, 4 (3+4); all, or nearly all, of the IIIBr series are 2, but IIIBr 4 (3+4) series more or less frequently follow IIBr 2 series, particularly on the posterior arms; some, most, or all of the division series following the IIIBr series are 4 (3+4).

Geographical range.—From Fukien Province, China, Formosa (Taiwan), southern Japan, the Philippine and Bonin Islands, and Australia south to Ballina, New South Wales, and the Abrolhos Islands, Western Australia, westward to Java.

Bathymetrical range.—From the shore line down to 150 meters. Of the 11 included species 8 do not descend below 60 meters, 6 are found between 60 and 120 meters, and only 1 descends deeper than 120 meters.

Remarks.—The genus *Comantheria* as here understood is a rather heterogeneous assemblage of forms, a few of which occupy a somewhat isolated position.

One group of species (comprising *polycnemis*, *alternans*, and *briareus*) includes forms in which the centrodorsal seldom or never bears functional cirri and is often reduced to a very small stellate plate. In all these species the number of arms reaches a maximum of from 160 to 170.

Because of the large size, great number of arms, and absence of functional cirri, these species often at first glance resemble the species of *Comanthina*, and in very large individuals there may be a heavy interbrachial plating as in that genus. In some cases also they might be taken for exceptionally large individuals of *Comanthus timorensis* without cirri. But their general appearance is quite characteristic, and after a little experience with them they may be distinguished at a glance. From the species of *Comanthina* they are usually easily distinguished by their less massive proximal structure, the usually narrower and always more convex division series, and the tendency to develop synarthrial and articular prominences, especially in *briareus*. From the species of *Comanthus* they are readily distinguished by the short IIIBr series.

Another species (*rotula*) possesses only rudimentary cirri, but only 40 arms. This, however, is not closely related to the preceding species, but to another group of forms (including *weberi*, *perplexum*, and *intermedia*) in which the cirri are well developed and the arms are always about 40 in number. These species (*rotula*, *weberi*, *perplexum*, and *intermedia*) are more likely to be confused with *Comanthus timorensis* than with any other species of the genus *Comantheria*. But the curious wheel-like appearance resulting from the possession of 40 arms and the short IIIBr series distinguish them at once from any species of *Comanthus*.

In another group of species (including *grandicalyx* and *imbricata*) the cirri are large and robust and in length are equal to about one-third of the arm length. The number of arms varies between 30 and 68. The general aspect of these species, due to the large centrodorsal and long and robust cirri, is quite different from that of any of the other species. In a general way they resemble the species of *Comanthus* having large stout cirri, especially *C. japonica* and *C. pinguis;* but their appearance is quite characteristic and a glance at the IIIBr series distinguishes them at once.

The remaining two species, which do not in any way resemble each other, are curious in having terminal combs as far as the thirty-first brachial (*delicata*), or even occurring at intervals on the distal pinnules. In *taviana* the cirri are small, with relatively few segments, while in *delicata* these organs are large and stout, with more numerous segments. The last named has a general appearance quite different from that of any other comasterid.

KEY TO THE SPECIES IN THE GENUS COMANTHERIA

a^1. Centrodorsal greatly reduced; cirri absent or, if present, rudimentary.

b^1. More than 45 arms.

c^1. IVBr series 2; succeeding division series 2 except the outermost, which are 4 (3+4); 85–160 arms (Philippine to the Kei Islands; 0–51 meters) ---------------- **polycnemis**, p. 485.

c^2. IVBr series 4 (3+4).

d^1. VBr series 2; VIBr series, when present, 4 (3+4); 80–160 arms (Philippines to Port Molle, Queensland, and the Abrolhos Islands, Western Australia; 0–51 meters) ---------------- **alternans**, p. 488.

d^2. VBr and following series 4 (3+4); 48–170 (usually 70–100) arms (Java and northern Australia to the Philippines and Formosa [Taiwan]; 0–91 meters) -- **briareus**, p. 492.

b^2. Arms 40 in number (Timor, Aru Islands, northwestern Australia, and the Philippines; 0–27 [?54] meters) ---------------- **rotula**, p. 503.

a^2. Centrodorsal well developed, usually large and thick, bearing numerous long and well-developed cirri.

b^1. Cirri of moderate size, in length equal to between one-eighth and one-fifth of the arm length.

c^1. Cirri with 20–28 (usually 24–26) segments, of which the longest are about one-third again as long as broad; 31–48 arms (Sagami Bay, Japan, to Amoy, China; down to about 150 meters) ---------------- **intermedia**, p. 508.

c^2. Not more than 20 (16–20) cirrus segments, of which the distal bear dorsally a tubercle in the proximal portion in addition to the distal tubercle or transverse ridge, so that the dorsal profile of the distal cirrus segments is bidentate.

d^1. No combs on the middle and distal pinnules.

e^1. Cirri larger and more numerous, XXXII, 19–20, about 20 mm. long; 40 arms (Lesser Sunda Islands; 69 meters) ---------------- **weberi**, p. 505.

c^2. Cirri smaller and fewer, apparently XV–XX, 16–19, about 13 mm. long; 44 arms (off Ballina, New South Wales; 49–51 meters) ---------------- **perplexum**, p. 506.

d^2. Combs occur on most of the genital pinnules, as well as on many of the distal pinnules; 36 arms (Jolo Archipelago; 89 meters) ---------------- **taviana**, p. 510.

b^2. Cirri large and robust, in length equal to about one-third of the arm length.
  c^1. Longest cirrus segments about as long as broad; combs confined to the oral pinnules.
    d^1. Division series broad, nearly or quite in lateral apposition, the component ossicles with smooth distal edges; brachials with the distal edges not noticeably produced; 47–48 arms (Canton and Fuchow, China)........................... **grandicalyx**, p. 513.
    d^2. Division series narrow, strongly convex dorsally, the component ossicles with everted and spinous distal edges; brachials with strongly produced and spinous overlapping distal edges; cirrus segments with more or less overlapping distal ends; 30–68 arms (southern Japan and the Bonin Islands; 20–91 meters).......... **imbricata**, p. 515.
  c^2. Longest cirrus segments from one-third to one-half again as long as broad; combs occur at irregular intervals to about the thirtieth pinnule; 30–47 arms (Lesser Sunda, Philippine and Bonin Islands; 54[?27]–89 meters)............................ **delicata**, p. 521.

COMANTHERIA POLYCNEMIS (A. H. Clark)

Plate 56, Figure 162

[See also vol. 1, pt. 2, fig. 137 (division series), p. 79]

Phanogenia typica (part) A. H. Clark, Smiths. Miscell. Coll. (Quarterly Issue), vol. 52, pt. 2, 1908, p. 203 (*Albatross* station 5139).

Comanthus polycnemis A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 396 (*Albatross* stations 5139, 5147, 5248, 5249 [type locality], 5250, 5251, 5252, 5253, 5254); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed); Amer. Journ. Sci., vol. 29, 1910, art. 30, p. 354 (4-rayed specimen from the Philippine Is.; anterior ray missing).

Comantheria polycnemis A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 89 (synonymy; range); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43 (in key; range; references; station 99); p. 272 (listed).

Diagnostic features.—A very large species with very numerous arms and a small stellate centrodorsal. The IIBr series are 4 (3+4) but the succeeding division series are all 2 except the outermost, which are largely or mostly 4 (3+4).

Description.—The centrodorsal varies from pentagonal with concave sides to strongly stellate. Its dorsal surface is even with or depressed somewhat below that of the radials.

There are no cirri.

The ends of the basal rays are visible as very small tubercles at the angles of the centrodorsal.

The radials vary from short, four or five times as broad distally as long, to rather long, twice as broad distally as long, with the proximal border about equal to the median length. The IBr_1 are about as long as, or slightly longer than, the radials and are in close lateral apposition; their distal border is from four to six times the median length. The IBr_2 (axillaries) are triangular, twice as long as the IBr_1 and twice as broad as long. The IIBr series are 4 (3+4), rarely 2. The IIIBr, IVBr, VBr, and VIBr series (if the last be present) are 2, except that the outermost division series, especially on the outer side of each IIIBr series, are commonly 4 (3+4), and a few of the other division series are usually replaced by 4 (3+4) series in each specimen. The IBr_2 (axillaries) are well separated laterally, and all the division series are well rounded dorsally and laterally, being entirely free and somewhat widely separated from each other.

The arms are 90–160 in number, from 120 to 150 mm. in length, increasing slightly in width to about the twelfth or fourteenth brachials and thence gradually tapering distally. The first 2 brachials are similar, slightly wedge-shaped, about twice as broad as long; the first are united interiorly, but the second are entirely free interiorly. The first syzygial pair (composed of brachials 3+4) is oblong, usually about twice as broad as long. The next 2 brachials are oblong, two or three times as broad as long, and those following become triangular, about half again as broad as long, about the middle of the arm becoming wedge-shaped, twice as broad as long, or, in some specimens, very short wedge-shaped. The division series are smooth; but the brachials from the fifth onward have more or less, often very strongly, overlapping distal ends which are armed with minute spines.

One or two of the posterior postradial series are sometimes smaller than the others, with ungrooved arms and no ambulacral grooves running to them from the disk.

Syzygies occur between brachials 3+4, again from between brachials 12+13 to between brachials 19+20 (usually in the vicinity of the thirteenth or fifteenth brachials), and distally at intervals of 4 or 5 muscular articulations.

The disk is 30 mm. in diameter, naked or with scattered concretions in the anal area. The mouth is marginal, radial, or interradial. The anal area is large and the anal tube is central.

P_D is from 18 to 20 mm. in length, rather slender, scarcely, if at all, larger than the following pinnules. It is composed of about 40 segments, usually all slightly broader than long. The terminal comb consists of 9–11 small rounded triangular teeth, all, or nearly all, of which are repeated in miniature on the inner side of the segments. The next pinnule ordinarily is on the outermost division series; it is from 14 to 18 mm. long and resembles P_D, being very slightly, if at all, more slender. P_1 is 12 mm. long, as stout basally as the preceding pinnule, but tapering somewhat more rapidly because of its lesser length. P_2 is 9 mm. long, about as stout basally as P_1, but tapering rapidly. It is composed of about 22 segments, which at first are twice as broad as long, becoming about as long as broad on about the sixth. The following pinnules are similar, very slightly stouter basally and not tapering so rapidly, about 8 mm. long; their segments have prominent and slightly overlapping finely spinous distal ends. Distally the pinnules gradually become moderately slender, 7 or 8 mm. in length, with 15–18 segments, most of which are about as long as broad.

The color in alcohol is brownish yellow, a line from the angles of the centrodorsal to the perisome at the interradial angles of the calyx continuing in a lateral line along the division series and arms dark yellowish or reddish brown, the pinnules greenish yellow and the perisome brown; or bright green; or bright yellow, darker ventrally; or plain reddish, yellowish, or purplish brown, darker on the ventral surface; or dark reddish brown, with the pinnules and ventral surface evenly and finely marbled with green and reddish brown in about equal proportions.

Notes.—The specimen from *Siboga* station 99 has 85 arms which are 130 mm. in length.

Mortensen's specimen from a coral reef off Jolo seems to be referable to this species rather than to *C. rotula*. It has 45 arms. There are 7 IIBr 4 (3+4) series, all followed by IIIBr 2 series, and 3 IIBr 2 series, all of which are followed by IIIBr

4 (3+4) series. The IVBr series are all 2. In Mortensen's specimen from off Jolo in about 46 meters, 2 of the IIBr series, both on the same IBr series, are 2.

In one of the specimens from *Albatross* station 5139 the centrodorsal is very small and stellate, the 5 interradial processes being tipped by the well-rounded ends of the basal rays which lie wholly proximal to the radial ring. The narrow radial portion of the centrodorsal which lies between the interradial processes is somewhat irregular, retaining the last traces of obsolete cirrus sockets. The center of the dorsal pole is occupied by a small shallow pit.

The radials are very short, about five times as broad as the median length. The radial portions of the centrodorsal just proximal to them are rather deeply sunken. The proximal border of the radials is slightly convex—bowed down between the ends of the basal rays. The outer fourth of the radials is slightly swollen.

The IBr_1 are trapezoidal, nearly three times as long as the very short radials, proximally about three times as broad as the median length. The proximal border is very slightly concave, and the distal border is straight. The lateral edges are in contact throughout. The IBr_2 (axillaries) are triangular, only slightly longer than the IBr_1, about three times as broad as long. The anterior angle is greater than a right angle, and the lateral angles are very sharp.

The 10 IIBr series are 4 (3+4).

Of the 2 specimens from the Danish expedition to the Kei Islands station 20, one has about 90 arms 130 mm. long and the cirri VIII, 12–13. The other specimen is small. One of the specimens from station 30 is small, with about 100 arms which are about 100 mm. long. The 10 IIBr series are all 4 (3+4). Of the 20 IIIBr series, 19 are 2 and 1 is 4 (3+4). The centrodorsal is greatly reduced and stellate. The other specimen is small but well developed. The example from station 40 is small, with about 100 arms about 100 mm. long. All of the IIBr series are 4 (3+4) and all of the IIIBr series are 2. The IVBr series are mostly 2. The outermost division series are usually 4 (3+4). The centrodorsal is greatly reduced and sharply stellate.

Abnormal specimen.—One of the specimens from *Albatross* station 5249 is 4-rayed, the anterior ray being absent.

Localities.—*Albatross* station 5248; Gulf of Davao; Lanang Point bearing S. 33° W., 0.4 mile distant (lat. 7° 07′ 25″ N., long. 125° 40′ 24″ E.); 33 meters; coral; May 18, 1908 [A. H. Clark, 1909] (3, U.S.N.M., 35050, 35098).

Albatross station 5249; Gulf of Davao; Lanang Point bearing N., 1 mile distant (lat. 7° 06′ 06″ N., long. 125° 40′ 08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 25467, 35030). Pl. 56, fig. 162.

Albatross station 5254; Gulf of Davao; Linao Point bearing N. 44° E., 0.7 mile distant (lat. 7° 05′ 42″ N., long. 125° 39′ 42″ E.); 38 meters; sand and coral; May 18, 1908 [A. H. Clark, 1909] (4+, U.S.N.M., 34999, 35017, 35020).

Albatross station 5251; Gulf of Davao; Linao Point bearing N. 32° E., 1.1 miles distant (lat. 7° 05′ 12″ N., long. 125° 39′ 35″ E.); 36 meters; coral; May 18, 1908 [A. H. Clark, 1909] (3, U.S.N.M., 35102).

Albatross station 5250; Gulf of Davao; Linao Point bearing N. 22° E., 1.1 miles distant (lat. 7° 05′ 07″ N., long. 125° 39′ 45″ E.); 42 meters; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35052).

Albatross station 5253; Gulf of Davao; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909] (3, U.S.N.M., 35001, 35055, 35072).

Albatross station 5252; Gulf of Davao; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral bottom; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34991).

Siboga station 99; anchorage off North Ubian, Sulu (Jolo) Archipelago (lat. 6° 07′ 30″ N., long. 120° 26′ 00″ E.); 16–23 meters; lithothamnion bottom; June 28–30, 1899, June 28 and 29 to the west and June 30 to the east of the island [A. H. Clark, 1918] (1, Amsterdam Mus.).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; coral reef; March 20, 1914 (1); about 36 meters; March 21, 1914 (1); about 46 meters; March 17, 1914 (1).

Albatross station 5139; in the vicinity of Jolo; Jolo Light bearing S. 51° W., 3.6 miles distant (lat. 6° 06′ 00″ N., long. 121° 02′ 30″ E.); 36 meters; coral sand; February 14, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 34965, 35033).

Albatross station 5138; in the vicinity of Jolo; Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 35 meters; sand and coral; February 14, 1908 (1, U.S.N.M., 35165).

Albatross station 5147; in the vicinity of Siasi, Jolo Archipelago; Sulade Island (E.) bearing N., 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35032).

Albatross station 5148; in the vicinity of Siasi; Sirun Island (N.) bearing S. 80° W., 3.8 miles distant (lat. 5° 35′ 40″ N., long. 120° 47′ 30″ E.); 31 meters; coral sand; February 16, 1908 (1, U.S.N.M., 34972).

Albatross; Philippine Islands [A. H. Clark, 1909] (1, U.S.N.M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 20; about 50 meters; sand and shells; April 14, 1922 (2); station 30; about 40 meters; sand and shells; April 18, 1922 (2); station 40; about 20 meters; sand; April 25, 1922 (1).

Geographical range.—From the Philippine to the Kei Islands.

Bathymetrical range.—Littoral and sublittoral; from the shore line down to 51 meters. The average of 12 records is 36 meters.

History.—This species is only known from the specimens collected by the *Albatross* in 1908, nearly all of which were recorded in 1909, the single specimen collected by the *Siboga* in 1899 and recorded in 1918, and the 8 specimens collected by Dr. Th. Mortensen in 1914 and 1922 and previously unrecorded.

COMANTHERIA ALTERNANS (P. H. Carpenter)

[See vol. 1, pt. 1, fig. 167 (central structures), p. 229; pt. 2, figs. 169, 170 (analysis of arm structure), p. 86; fig. 188 (dorsal view), p. 108]

Actinometra alternans P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 208 (description; habitat unknown).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed); p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 733 and following (discussion of Bell's method of formulation and corrected formula).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 169 (Port Molle).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 46, 48, 50, 58, 61, 329, 330, 333, 366, 382.—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (identity of type specimen); Memoirs Australian Mus., vol. 4, 1911, p. 714 (of *Alert* report=*alternans*); p. 716 (credited to Australia by Carpenter); Crinoids of the Indian Ocean, 1912, p. 31 (of *Alert* report=*alternans*); p. 36 (of P. H. Carpenter, 1888=*alternans*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 75 (identity of Bell's specimens).

Comaster alternans A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia alternans A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus alternans A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 397 (*Albatross* stations 5252, 5254); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).—H. L. Clark, Records Western Australian Mus., vol. 1, pt. 3, 1914, p. 134 (Abrolhos Is.; characters); Carnegie Institution of Washington Publication 212, 1915, p. 101 (Mer; 18 fathoms); The Echinoderm Fauna of Torres Strait, 1921, p. 8 (secured by the Carnegie Exped.); p. 17 (range; single specimen found at Mer; reactions); pl. 20, fig. 1; Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Western Australia).

Comantheria alternans A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (identity); p. 178 (no locality; redescription of the type); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (East Indian species occurring south to Port Molle); p. 443 (range on the east coast); Memoirs Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia); p. 721 (occurs south to Port Molle); p. 733 (in key); p. 751 (annotated synonymy; characters; Port Molle; distribution; description of the type at Leyden); Crinoids of the Indian Ocean, 1912, p. 31 (=*Actinometra alternans* Bell, 1884); p. 36 (=*Actinometra alternans* P. H. Carpenter, 1888); p. 90 (synonymy; summary of previous records; description of the type); Smiths. Miscell. Coll. vol. 61, No. 15, 1913, p. 13 (published reference to the specimen in the British Museum; Port Molle, 12–20 fathoms, rock); p. 75 (=*Actinometra alternans* Bell, 1884, part).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 83 (Amboina); p. 87 (Amboina; Professor Strubell; characters of the specimen).—A. H. Clark, Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of the distribution in Australia); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43 (in key; range).

Comanthus polycnemis H. L. Clark, Records Western Australian Mus., vol. 1, pt. 3, 1914, p. 135 (Abrolhos Is.; characters of the specimen); Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Western Australia).

Diagnostic features.—A very large species with very numerous arms and a small stellate centrodorsal. The IIBr series are 4 (3+4), the IIIBr series are 2, the IVBr series are 4 (3+4), the VBr series are 2, and the VIBr series, if present, are 4 (3+4). There may be a reversal of the sequence on some of the rays, but the alternation is always evident.

In general appearance this species resembles *briareus* rather than *polycnemis*.

Description.—The centrodorsal is a pentagonal disk with more or less concave sides, flat or slightly hollowed in the center, its dorsal surface slightly higher than the dorsal surface of the radials. There are no distinct traces of functional cirrus sockets.

There are no cirri.

The ends of the basal rays are visible as low tubercles at the angles of the centrodorsal.

The radials are very short. The IBr$_1$ are about twice as long as the radials and are almost entirely united laterally. The IBr$_2$ (axillaries) are triangular, scarcely half again as long as the IBr$_1$, nearly three times as broad as long, and laterally free. The IIBr series are 4 (3+4); the IIIBr series are 2; the IVBr series are 4 (3+4); the VBr series are 2; the VIBr series are 4 (3+4). VIBr series are rare or absent, and the VBr series also are usually more or less deficient. Beyond the IBr series the division series are rounded dorsally and laterally and widely separated, except for the first segments following each axillary, which are interiorly united for nearly the whole length. The division series may be somewhat variable; though series of 4 (3+4) and 2 are in equal proportions when taken as a whole, they do not necessarily alternate with each other. The tendency is, however, to an alternating arrangement.

The arms are 80–160 in number, from 90 to 125 mm. long, and resemble those of *C. polycnemis.*

The disk and the pinnules seem not to differ from those of *C. polycnemis.*

The color in alcohol is yellow or blackish brown.

Notes.—The specimen from Amboina as described by Reichensperger is typical. The centrodorsal is stellate. There are no cirri. There are 96 arms which are from 100 to 110 mm. long. All of the IIBr series are 4 (3+4). All of the IIIBr series are 2. The IVBr series are all 4 (3+4). The VBr series are 2. The VIBr series are 4 (3+4). There is no further division. The disk bears isolated tubercles. The mouth is radial. The color in alcohol is dark brown.

The type specimen in the Leyden Museum, which is without indication of locality, was thus described by Carpenter.

The centrodorsal is a pentagonal disk slightly hollowed in the center, with its angles produced into 5 blunt processes which are separated from the radials by the outer ends of the basal rays.

There are no cirri nor any distinct traces of functional cirrus sockets.

The radials are short, below the level of the centrodorsal, but not separated from it by distinct clefts. The IBr_1 are much longer and broader, broadly hexagonal, and partly united laterally. The IBr_2 (axillaries) are barely half as long again as the IBr_1 and are almost triangular, with very open angles. The division series are quite free from the IBr axillary onward, and may divide five, or rarely six, times. The successive division series are alternately 4 (3+4) and 2. The first ossicles following each axillary are quite free, or but slightly united laterally.

There are numerous arms about 125 mm. long which consist of 150+ brachials. The first 2 brachials are about equal in length and are nearly oblong. The first syzygial pair (composed of brachials 3+4) is longer, with its distal edge sloping obliquely inward so that the outer side is the longer. The next few brachials are shorter and bluntly wedge-shaped, and those following are longer again, more sharply wedge-shaped and overlapping, with slight spines on their distal edges. The overlap is sometimes so marked that the brachials seem to have a sharp dorsal keel with spiny edges. After about the thirtieth the brachials become shorter, blunter, and more oblong, and squarer and less strongly overlapping toward the arm tips.

Syzygies occur between brachials 3+4, again from between brachials 13+14 to between brachials 18+19, and distally at intervals of 4 or 5 muscular articulations.

The $IIBr_2$ and $IVBr_2$ bear slender pinnules of moderate length, of which the first is slightly the longer. P_1 is a good deal shorter, and P_2 still more so. The next 6 or 8 pinnules are a little longer, consisting of 15 more massive segments, the lower of which are trapezoidal, with their outer distal angles produced into short processes. The pinnules following become gradually longer and more slender and are composed of longer segments, still retaining processes on their outer sides and fringed with small spines. The proximal pinnules as far as the fourth brachial have a small terminal comb, which occurs also on some of the larger pinnules immediately following.

The diameter across the radial ring is 13 mm. The color in alcohol is blackish brown.

I examined this specimen at the Leyden Museum in 1910. There are about 90 arms. The division series are regularly alternating, the IIBr series being 4 (3+4), the IIIBr series 2, the IVBr series 4 (3+4), the VBr series 2, and the VIBr series, when present, 4 (3+4). There are almost no exceptions to this regular alternation. The centrodorsal is in shape like an *Hippasteria phrygiana*, not as yet having become sharply stellate.

One of the specimens from the Abrolhos Islands, as recorded by Dr. H. L. Clark, is small, with 34 arms 60 mm. long. On 3 of the rays the IIBr series are 4 (3+4), the IIIBr series are 2, and the IVBr series are 4 (3+4) again. On a fourth ray, on one side, the IIIBr series is 4(3+4) and the IVBr series is 2. On the fifth ray both of the IIBr series are 2, and the IIIBr series are 2 also. The centrodorsal is flat, less than 3 mm. in diameter. There are II cirri; the larger is broken, and the smaller has 15 very short and slightly swollen segments.

The other specimen from the Abrolhos Islands has 57 arms which are 60 mm. long. The cirri are XV, 15; but they have the appearance of being fugaceous, and the small thin centrodorsal adds weight to such an impression.

The color of the former in alcohol is light wood brown and of the latter a very deep olive green, with the young arms and the cirri pale brown or dirty cream color.

Localities.—*Albatross* station 5254; Gulf of Davao; Linao Point bearing N. 44° E., 0.7 mile distant (lat. 7° 05′ 42″ N., long. 125° 39′ 42″ E.); 38 meters; sand and coral; May 18, 1908 [A. H. Clark 1909] (1, U.S.N.M., 35034).

Albatross station 5252; Gulf of Davao; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34995).

Amboina; Professor Strubell [Reichensperger, 1913].

No locality [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911, 1912] (1, L. M.).

Mer, Murray Islands, Torres Strait; outer portion of the southwestern reef; 33 meters; H. L. Clark, October 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 521).

Alert; Port Molle, Queensland; 22–36 meters [Bell, 1884; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Abrolhos Islands (Houtmans Rocks), Western Australia [H. L. Clark, 1914] (2, W. A. M.).

Geographical range.—From the Philippines southward to Port Molle, Queensland, and the Abrolhos Islands, Western Australia.

Bathymetrical range.—Littoral and sublittoral; from the shore line down to 51 meters.

History.—This species was originally described by Dr. P. H. Carpenter from a specimen without locality in the Leyden Museum in 1881. A specimen dredged by the *Alert* at Port Molle, Queensland, was recorded by Prof. F. Jeffrey Bell in 1884.

In 1909 I recorded specimens from 2 *Albatross* stations in the Philippines, in 1911 and again in 1912 I published notes on the type specimen at Leyden, and in 1913 I confirmed Bell's identification of the *Alert* specimen from Port Molle.

In 1913 Dr. August Reichensperger recorded this species from Amboina, where it had been collected by Professor Strubell; in 1914 Dr. H. L. Clark recorded it from the Abrolhos Islands, Western Australia; and in 1915 he recorded it from Mer, in the Murray Islands, where he had personally collected it in 1913.

COMANTHERIA BRIAREUS (Bell)

Plate 57, Figures 163, 164; Plate 64, Figure 178

[See also vol. 1, pt. 2, fig. 253 (arm), p. 205; pl. 9, fig. 1021 (analysis of arm structure); pl. 12, fig. 1030 (arm); pl. 17, fig. 1077 (oral pinnule); pl. 24, fig. 1151 (disk)]

Actinometra, sp. P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 210 (Pandan, near Bohol); Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 521 (Banda).

Antedon briareus Bell, Proc. Zool. Soc. London, 1882, p. 534 (specific formula; Port Denison).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 740 and following (discussion of Bell's method of formulation and corrected formula).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 163 (description; Port Denison); pl. 14.—A. H Clark, Memoirs Australian Mus., vol. 4, 1911, p. 714 (identity); p. 716 (credited to Australia by Carpenter); Crinoids of the Indian Ocean, 1912, p. 31 (identity).

Actinometra magnifica P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 57 (specific formula); pl. 56, fig. 7; vol. 26, pt. 60, 1888, pp. 330, 333, 382 (Philippines; characters).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 36 (identity).

Actinometra briareus P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 48, 58, 330, 366, 382 (discussion).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 36 (identity).

Actinometra divaricata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 332 (description; Banda, 17 fathoms); pl. 63, figs. 6–8.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 11 (collected by Brock at Amboina); p. 94 (Amboina; notes on the specimen); p. 113 (in Göttingen Mus.).—Koehler, Revue suisse de zool., vol. 3, 1895, p. 289 (Bay of Amboina; Java Seas; notes); Mém. soc. zool. France, vol. 8, 1895, p. 421 (Sunda Is.; Biliton; notes).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 395 (synonym of *briareus*); Crinoids of the Indian Ocean, 1912, pp. 36, 37 (identity); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 75 (identity).

Actinometra parvicirra (part) Bell, Proc. Zool. Soc. London, 1894, p. 394 (Baudin I.).—A. H. Clark, Memoirs Australian Mus., vol. 4, 1911, p. 752 (correction); Crinoids of the Indian Ocean, 1912, p. 90 (correction; also B. M., MS.); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (correction; B. M., MS.; Baudin I.).

Comaster briareus A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Comaster divaricata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Comaster magnifica A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia briareus A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Phanogenia divaricata A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Phanogenia magnifica A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus divaricata A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 205 (*Albatross* stations 5138, 5147; also Philippines); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus alternans A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 206 (*Albatross* station 5142).

Comanthus magnifica A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus briareus A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 395 (history; *divaricata* a synonym; *magnifica* very closely related; *Albatross* stations 5138, 5142, 5147, 5148, 5249, 5254); p. 396 (compared with *polycnemis*); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 365 (19° 42.1′ S., 116° 49.8′ E., 50 fathoms); p. 366 (discussion); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (identity of preceding).—H. L. Clark, Biol. Results Fishing Experiments F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, pp. 14, 15 (comparison with *C. perplexum*); Echinoderm Fauna of Torres Strait, 1921, p. 17 (28 specimens from the Philippines recorded; color in life); p. 192 and following (range); Records Australian Mus., vol. 15, No. 2, Nov. 18, 1926, p. 184 (Feather Reef; Surprise Shoal, 7 fathoms).

Comanthus (*Comantheria*) *briareus* A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 535 (*Albatross* station 5321; and Mahinog, Caunguin I.).

Comantheria briareus A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 437 (northwest Australia, 9 fathoms); p. 439 (East Indian species occurring south to Perth and Port Denison); p. 443 (range on the east coast); p. 444 (range on the west coast); p. 454 (localities; descriptions of specimens); p. 465 (association with other species).—R. H[orst], in A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 192, footnote (West Java).—A. H. Clark, Mem. Australian Mus., vol. 4, 1911, p. 717 (known to Carpenter from Australia); p. 721 (occurs south to Port Denison); p. 723 (Port Walcott); p. 733 (in key); p. 752 (annotated synonymy; characters; Australian records; Baudin I., 8–15 fathoms; range); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 23 (compared with *C. rotula* and *C. weberi*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 4 (resemblance of *Capillaster macrobrachius* to this species); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (identity); p. 390 (north of Port Walcott, 50 fathoms; southwestern Australia); Crinoids of the Indian Ocean, 1912, p. 31 (=*Antedon briareus* Bell, 1884); p. 36 (=*Actinometra briareus* and *A. divaricata* P. H. Carpenter, 1888); p. 37 (=*Actinometra divaricata* Hartlaub, 1891); p. 39 (=*Actinometra parvicirra* Bell, 1894, part); p. 90 (synonymy; summary of previous records); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (published references to specimens in the British Museum; localities; characters of the specimens); p. 75 (synonymy).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 82 (Aru Is.); p. 87 (Aru Is.; Strasse von Dobo, 50 m.; characters of the 2 specimens).—A. H. Clark, Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 222 and following (detailed account of the distribution in Australia); Proc. Biol. Soc. Washington, vol. 29, 1916, p. 105 (comparison with *C. intermedia*).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 234 (Western Australia, No. 3430; southwestern Australia, No. 6133).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43 (in key; range); p. 43, footnote (includes *Comanthus callipeplum*); p. 44 (synonymy; notes; stations 33, 50, 60, 96, 125, 144, 240, 257, 282, 299); pp. 271–275 (listed).

Comantheria magnifica A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 36 (identity); p. 90 (synonymy; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43 (in key; range).

Actinometra duplex (B. M., MS.) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 90 (in synonymy); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (B. M., MS.; Bassett-Smith Bank).

Actinometra typica (B. M., MS.) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 90 (in synonymy); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 13 (B. M., MS.; Billiton).

Diagnostic features.—A large species with usually very numerous arms. The centrodorsal is reduced to a thin subcircular, irregularly pentagonal, or substellate plate which is notched by obsolete cirrus sockets about the edges or bears a few irregularly distributed rudimentary cirri. The earlier portion of the arms is characteristically rugged, as a result of the development of low and very broad articular tubercles. The IIIBr series are 2, but the following division series are all, or nearly all, 4 (3+4).

Description.—The centrodorsal is a thin rounded pentagonal to stellate plate, usually more or less notched about the edges, which is on a level with or slightly below the level of the radials.

The cirri are absent in fully developed specimens; but there frequently occur occasional small rudimentary cirri irregularly placed around the periphery of the centrodorsal.

The ends of the basal rays are visible as minute tubercles at the angles of the centrodorsal.

The radials are very short, distally four or five times as broad as the median length. The IBr_1 vary from slightly longer than to about twice as long as the radials and are in close lateral apposition. The IBr_2 (axillaries) are triangular, two or two and one-half times as broad as long, twice as long as the IBr_1, and well separated laterally. The IIBr series are 4 (3+4), occasionally 2. The IIIBr series are 2, occasionally 4 (3+4). The IVBr and VBr series are 4 (3+4), both occasionally 2, the latter more or less irregular in their occurrence. The IBr_2 (axillaries) and the division series are well rounded dorsally and laterally and rather widely separated laterally.

The arms are 55–170 (usually 70–100) in number, from 90 to 120 mm. in length. The first 2 brachials are subequal, slightly wedge-shaped, about twice as broad as the exterior length, the first entirely united interiorly, the second free interiorly. The first syzygial pair (composed of brachials 3+4) is oblong, nearly or quite twice as broad as long. The next 2 brachials are oblong, twice as broad as long or somewhat broader, those following becoming obliquely wedge-shaped or even triangular, twice as broad as long (somewhat longer in small specimens), and gradually short wedge-shaped or even almost discoidal in the outer half of the arms. The elements of the division series have unmodified distal ends, but the second or fourth and following brachials have strongly overlapping distal ends which are armed with fine spines. One or both of the posterior postradial series are usually shorter than the others and ungrooved.

Syzygies occur between brachials 3+4, again from between brachials 12+13 to between brachials 14+15, and distally at intervals of 4 or 5 (usually 4) muscular articulations.

The disk is from 30 to 40 mm. in diameter, naked, or with a few concretions in the large anal area. The mouth is marginal, radial to interradial. The anal tube is approximately central.

P_D is comparatively small and slender, 15 mm. long, composed of 35–40 segments, which at first are broader than long but become about as long as broad on the fifth or eighth and following. The terminal comb has 8–11 small rounded triangular teeth, most of which are ordinarily repeated in reduced form on the inner side of the pinnule. The following pinnules gradually decrease in length and slightly in stoutness, P_P being 12 or 13 mm. long, P_1 about 10 mm. long, and P_2 7 or 8 mm. long, the last very delicate, with 20–22 segments. P_3 is about 7 mm. long, slightly stouter than P_2 and bearing a gonad. P_4 and the following pinnules are 7 mm. long, slightly stouter than P_3, with all of the component segments broader than long, with prominent and slightly overlapping distal ends and a spinous surface. Distally the pinnules gradually become more slender, the distal pinnules being about 9 mm. long, slender, with 15–18 segments which have somewhat prominent distal ends and the longest of which are about as long as broad. The terminal combs persists usually as far as P_6 or P_8, sometimes to P_{12}.

The color in alcohol is usually dull yellow, green, or white, with a broad light or dark reddish or yellowish brown line running outward from the angles of the centrodorsal and continued as a broad lateral line along the division series and arms. Some specimens are entirely dark yellowish, reddish or blackish brown, or light or dark green, or brown finely marbled ventrally with green, the two colors in about equal proportions, or yellow.

Notes.—The specimen from Sebesi Strait has 57 arms 165 mm. long. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. Of the 20 IIIBr series, 17 are 2 and 3 are 4 (3+4). The following division series are all 4 (3+4). The centrodorsal is very small, pentagonal with slightly produced angles, and is slightly sunken below the dorsal surface of the radial pentagon.

Professor Koehler's 4 specimens from Billiton were of large size. In 2 of these the centrodorsal is simply pentagonal and not so markedly stellate as in the others. In one of the specimens the second syzygy is at about the seventeenth or eighteenth brachial, while in the others it is found at about the twelfth.

The specimen from *Siboga* station 33 has about 95 arms which are about 100 mm. long. The color in alcohol is a uniform yellow brown.

The largest individual from *Siboga* station 50 has about 120 arms which are about 110 mm. long. One of the IIBr series is 2. The IIIBr series on the 5 rays are as follows: (1) 4 of 2; (2) 1 of 2 and 3 of 4 (3+4); (3) 4 of 2; (4) 4 of 4 (3+4), 2 of these being on the IIBr 2 series; (5) 1 of 4 (3+4) and 3 of 2. The centrodorsal is very small.

A similar example has all the IIBr series 4 (3+4). Of the IIIBr series, 13 are 2 and 7 are 4 (3+4); usually the IIIBr 4 (3+4) series occur in pairs on the same IIBr series. The centrodorsal is very small and stellate.

In another large specimen all of the IIBr series are 4 (3+4). One of the IIIBr series is 4 (3+4), all of the others being 2. The centrodorsal is very small and stellate, sunk well below the dorsal surface of the radials.

The fourth specimen has 37 arms 65 mm. long and V cirri.

Of the examples from *Siboga* station 299, one is a magnificent representative of the species with about 80 arms 155 mm. long. The IIIBr series are all 2, all of the other division series being 4 (3+4). The other is a slightly smaller individual. Both have exceedingly reduced stellate centrodorsals.

The specimen from *Siboga* station 60 is a medium-sized but robust and well-developed individual with about 100 arms which are 110 mm. in length. The centrodorsal is small and pentalobate.

One of the examples from *Siboga* station 282 is typical, with about 100 arms. The other is small, with 26 arms about 70 mm. long, undergoing adolescent autotomy. The arms on the several rays are 2, 1+6, 3+5, 2, and 6+1. The cirri are XVI, 12–13 (usually the latter), 8 mm. long.

The example from *Siboga* station 125 has about 80 arms which are about 100 mm. long. Only 7 of the IIIBr series are 2. Adolescent autotomy is in progress. The centrodorsal is irregularly polygonal, though sunk below the level of the dorsal surface of the radial ring. The color in alcohol is dark brown, the radials darker, the centrodorsal nearly white.

The specimen from *Siboga* station 144 has between 90 and 100 arms which are about 90 mm. long. Four of the IIIBr series are 4 (3+4). The centrodorsal is very small and stellate. The color in alcohol is a uniform yellow brown.

According to Carpenter the *Challenger* specimen from Banda has the centrodorsal stellate without traces of cirri and sunken a little below the level of the radial pentagon, the inner sides of which are somewhat cut away.

The IBr_1 are relatively long and are incompletely united laterally. The postradial series are quite free and may divide five times. The IIBr series are 4 (3+4). The IIIBr series are 2. The IVBr series are 4 (3+4). The VBr series, when present, are 4 (3+4).

The arms are very numerous, 18 or 20 to the ray, 90 mm. long. All of the arms are grooved, but the hinder arms are only faintly so and are very narrow and short, with from 100 to 120 slightly overlapping brachials. The anterior arms have rather more brachials. The lower brachials are shortly triangular, becoming more oblong, and finally nearly square.

Syzygies occur between brachials 3+4, 13+14, and 18+19, and distally at intervals of 4 or 5 muscular articulations.

The pinnules on the $IIBr_2$ and $IVBr_2$ are about equally long, reaching 12 mm. The following pinnules are considerably shorter, diminishing to that of the third brachial, which is the smallest. From that point the length increases slightly, but the pinnules are always comparatively short. The lower pinnules have a terminal comb as far as the fourth or fifth brachial, which is continued at intervals to the eleventh or twelfth.

The disk is 30 mm. in diameter, and is naked except for a few granules near the anal tube. The mouth is radial.

The color in alcohol is dark blackish brown.

In Carpenter's figure, 2 of the IIIBr series are shown as 4 (3+4), each of these IIIBr 4 (3+4) series being followed by 2 IVBr 2 series. In all other cases the division is regular.

The specimen from *Siboga* station 240 is typical, with about 100 arms which are about 120 mm. long.

The specimen from off Neira, Banda, in about 10 meters, has about 90 arms 140 mm. long. All 10 of the IIBr series are 4 (3+4). Of the 20 IIIBr series, 18 are 2, and 2, which are situated side by side, are 4 (3+4), both of these being on the same IIBr series. The IVBr series are all 4 (3+4) except that following the outer IIIBr 4 (3+4) series. There are 2 IVBr 2 series. The VBr series are almost equally 4 (3+4) and 2, though the latter are in a slight majority. The VIBr series, when present, are 4 (3+4). The centrodorsal is very small, sharply stellate, and is scarcely raised above the dorsal surface of the radial pentagon, from which it is separated by subradial clefts bridged over interradially by the ends of the basal rays. A single small defective basal segment of a cirrus remains. By its side is a minute bud representing a single cirrus segment, and there are 2 similar buds in other radial areas. The specimen from off Banda in about 20 meters has about 70 arms. The centrodorsal is very small and stellate.

According to Professor Koehler, one of the specimens from the Bay of Amboina has the centrodorsal pentagonal rather than stellate. The color in alcohol is gray.

The other specimen, which is larger, has the centrodorsal clearly stellate. Koehler says that it differs from typical *divaricata* in two rather important features; the mouth is interradial, and on almost all the rays the first pinnule is longer than the second. The color is deep violet.

In Brock's specimen from Amboina the stellate centrodorsal carries a few traces of cirri and rises above the level of the radials, while these last lie below the level of the IBr series.

The very young specimen from the Danish expedition to the Kei Islands station 15 seems to represent this species. There are 19 arms about 50 mm. long. The 8 IIBr series present are 4 (3+4). The single IIIBr series is 2 and is internally developed. The centrodorsal is greatly reduced and stellate. The specimen from station 26 has about 85 arms. The 10 IIBr series are 4 (3+4) and the 20 IIIBr series are 2. Of the IVBr series, 25 are 4 (3+4) and 15 are 2. The centrodorsal is stellate and is depressed to the level of the radial pentagon. One of the specimens from station 30 is small, with about 85 arms 110 mm. long. All the IIBr series are 4 (3+4). Of the IIIBr series, 11 are 2 and 7 are 4 (3+4). One of the IIBr series gives rise to 2 undivided arms. The centrodorsal is pentagonal and is sunken to the level of the radial pentagon. There is no trace of cirrus sockets on its periphery. The other specimen is similar but slightly smaller, with about 65 arms which are about 100 mm. long. The 10 IIBr series are 4 (3+4). Of the 20 IIIBr series, 12 are 2 and 8 are 4 (3+4). The centrodorsal is small, its dorsal surface even with that of the radial pentagon, pentagonal, with a deep notch in the middle of each side.

The specimen from Toeal is peculiar in having nine of the IIBr series 2 and only one 4 (3+4). The 2 posterior rays are very small, the IBr axillaries being not much more than one-third the width of the IBr_1.

The specimen from *Siboga* station 257 has about 50 arms which are about 90 mm. long.

The 2 similar specimens recorded by Reichensperger from the Aru Islands have 92 and 98 arms which are from 100 to 105 mm. long. In both the division is entirely regular, all the IIBr series being 4 (3+4) and all the IIIBr series 2. The centrodorsal is quite stellate, with the points of the star somewhat swollen. It does not project. There is no trace of cirri or of cirrus sockets. P_2 is slightly longer and stouter than P_1. P_3 is smaller and more slender. In the following pinnules the segments become broader and stouter, decreasing again in the distal pinnules. The disk is 30 mm. in diameter, and is naked except for a slight granulation. The color in life was yellow and black in cross bands; in alcohol it is entirely a blackish gray.

One of the specimens presumably from the vicinity of Perth, has 36 arms about 75 mm. long. All of the IIBr series are 4 (3+4). Two of the IIIBr series are 4 (3+4). There are no IVBr series. The centrodorsal is large and thin, with the dorsal pole 3.5 mm. in diameter and slightly concave. The cirri are XVII, 13–14, 8 mm. long, arranged in a single slightly defective row. They are rather slender. The color in alcohol is uniform purplish black.

This specimen is remarkable for the exceedingly close interior union of the IIIBr series. In the several extreme cases the elements of the IIIBr series and the first 2 brachials are as strongly flattened against each other as in the extreme cases among the Thalassometridae.

The other specimen is in general similar to the preceding. It has 48 arms. All of the IIBr series are 4 (3+4). Eight of the IIIBr series are 4 (3+4), the remainder being 2. Following 2 of the IIBr series, the same crowded conditions are noticeable as in the other specimen. The cirri are VIII, 13–16, 8 mm. long. The color in alcohol is blackish brown, the division series and arms having an irregular mediodorsal line of light yellow brown.

The specimen dredged by the *Gazelle* north of Port Walcott has nearly 100 arms which are about 100 mm. long. The IIBr series are all 4 (3+4). The IIIBr series are about equally 2 and 4 (3+4). The IVBr series are almost always present, 4 (3+4), rarely 2. VBr series are common, and VIBr series occur, all 4 (3+4). The centrodorsal is irregularly rounded pentagonal, countersunk to the level of the radials; the periphery is somewhat notched with obsolete cirrus sockets. The color in alcohol is light brownish.

The specimen from Baudin Island has between 75 and 80 arms.

The specimen from Feather Reef is large, with about 70 arms.

The example from Surprise shoal is small, with 40 or more arms.

The type specimen from Port Denison was thus described by Bell:

> Centrodorsal flattened; 15–20 marginal delicate cirri, formed of a few short joints.
>
> Arms more than 70.
>
> First radials obscured; second [IBr_1] in contact, at least three times as long as they are broad; third [IBr_2] widely triangular. Three distichals, the axillary a syzygy [IIBr 4 (3+4)]; two palmars [IIIBr 2]. If there is another division, there are again two joints; no syzygy. The first five or six brachials have nearly even edges; the succeeding ones are markedly wedge-shaped. A syzygy on the third brachial; succeeding syzygies rare.
>
> Second pinnules longer than first, very delicate, made up of a number of small joints; the succeeding pinnules stouter and more fleshy.
>
> This is one of the species in which there is a very considerable difference in the length of the arms; here some of the arms may be as much as 110 millim. long, while others are only 75 millim. There is an interradial plating, extending as far as the distichal [IIBr] axillary.
>
> The colour (in spirit) is dark brown.

The figure shows an individual with 71 arms. The IIBr series are all 4 (3+4). Two of the IIIBr series are 4 (3+4), the other 18 being 2. Nine of the IVBr series are 2, but all the rest are 4 (3+4). The centrodorsal is discoidal, apparently deeply hollowed in the center. There are about XVII very short and rudimentary cirri.

Carpenter noted the discrepancy between Bell's description and the figure. He pointed out that in the latter about two-thirds of the IVBr series are 4 (3+4), and also that there are 3 VBr series shown which Bell does not mention at all.

Dr. Th. Mortensen's specimen from off Jolo in about 29 meters has about 150 arms Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. The centrodorsal is very small, stellate, and deeply sunken within the radial circlet. One of the specimens from about 36 meters has about 150 arms. The centrodorsal is very small, slightly stellate, and is sunken below the level of the radial pentagon. The color is dark brown, with a broad light dorsal stripe on the arms and division series. The other specimen is small. All the IIBr series are 2; one of the IIIBr series is 4 (3+4), the rest being 2.

The specimen from *Siboga* station 96 has about 80 arms which are 105 mm. long. The centrodorsal is very small and stellate.

The example from Mahinog, Camiguin Island, has about 65 arms.

The specimen from the Sulu Sea taken in January, 1895, has 68 arms. It is rather stout, with short and strongly overlapping brachials and relatively large radials. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. The 4 IIIBr series following the 2 IIBr 2 series, which are both on the same ray, are 4 (3+4), the other 16 being 2. Following the IIIBr 4 (3+4) series, the IVBr series are 2, and following these there are 5 VBr 4 (3+4) series. On the other rays all the IVBr series are 4 (3+4). On 2 rays there is no further division. One ray has a single VBr 4 (3+4) series, and the last has 3 VBr series, two 2 and one 4 (3+4).

Semper's specimen from Pandanon was considered by Carpenter as representing a distinct species, which he called *magnifica*. In the key to the species of the *Parvicirra* group of *Actinometra* he placed it next to *divaricata* (the *Challenger* specimen from Banda), from which it was said to differ in having the rays closely united, the interradial perisome plated, and the mouth interradial, whereas in *divaricata* the rays are well separated and the mouth is radial. Collectively, *divaricata* and *magnifica* were said to differ from *briareus* in having the centrodorsal stellate without cirri, whereas in *briareus* there are XV–XX small cirri. Carpenter noted elsewhere that in *magnifica* and *divaricata* (as well as in *C. alternans*) the centrodorsal is "stellate, with few or no traces of any cirri at all."

In all of the specimens from Bantayan Reef, Cebu, the centrodorsal is greatly reduced and stellate.

Of the specimens from Port Galera, Mindoro, one has about 100 arms 140 mm. long; another has about 100 arms 130 mm. long; another has about 120 arms 125 mm. long. One specimen has about 130 arms.

Abnormal specimen.—A curious example from Port Galera, Mindoro, has 78 arms about 100 mm. long. All of the IIBr series are 2. Of the IIIBr series, 12 are 4 (3+4) and 8 are 2. Of the IVBr series, 15 are 4 (3+4) and 14 are 2. All 9 of the VBr series are 4 (3+4).

In spite of the curious irregularity of the arm division, the details of this specimen are those of *Comantheria briareus*, and it presents the characteristic facies of that form.

Localities.—West Java; J. F. van Bemmelen, 1894 [Horst, in A. H. Clark, 1911].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 90; Sebesi Strait, between Sumatra and Java; 36 meters; hard bottom; August 1, 1922 (1).

Billiton [Koehler, 1895; A. H. Clark, 1911 (as Sunda Islands)]. Same [A. H. Clark, 1913] (1, B. M.).

Siboga station 33; Bay of Pidjot, Lombok; 22 meters and less; mud, coral, and coral sand; March 24–26, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 455).

Siboga station 50; Bay of Badjo, western coast of Flores; down to 40 meters; mud, sand, or shells, according to locality; April 16–18, 1899 [A. H. Clark, 1918] (4, Amsterdam Mus.).

Siboga station 299; Boeka or Cyrus Bay, southern coast of Rotti Island (lat. 10° 52′ 24″ S., long. 123° 01′ 06″ E.); 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 60; Haingsisi, Samau Island, Timor; reef; 23 meters; April 27–28, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 282; anchorage between Nusa Besi and the northeastern point of Timor; 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (2, U.S.N.M., E. 461; Amsterdam Mus.).

Siboga station 125; anchorage off Sawan, Siau Island; 27 meters; stone and some lithothamnion; July 18–19, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 144; anchorage north of Salomakiëe (Damar) Island; 45 meters; coral and lithothamnion; August 7–9, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger; Banda; 31 meters [P. H. Carpenter, 1882, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

Siboga station 240; anchorage at Banda; 9–36 meters; black sand and coral; lithothamnion bank; November 22–December 1, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Banda; off Neira; about 10 meters; sand; June 1, 1922 (1); about 20 meters; sand; June 1, 1922 (1). Pl. 57, fig. 164.

Bay of Amboina; MM. Bedot and Pictet [Koehler, 1895; A. H. Clark, 1911].

Amboina; Dr. J. Brock [Hartlaub, 1891; A. H. Clark, 1911].

Siboga station 257; in Du-roa Strait, Kei Islands; down to 52 meters; coral; December 11, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 15; about 5 meters; sand and lithothamnion; April 10, 1922 (1); station 26; about 90 meters; sand; April 16, 1922 (1); station 30; about 40 meters; sand and shells; April 18, 1922 (2). Pl. 57, fig. 163.

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Toeal; about 2 meters; rocky shore; March 23, 1922 (1).

Aru Islands; Dobo Strait; 50 meters; Dr. H. Merton, March 20, 1908 [Reichensperger, 1913].

?Vicinity of Perth, Western Australia; Hamburg southwest Australia expedition, 1905 [A. H. Clark, 1911] (2, Berl. M., 6133).

Gazelle; north of Port Walcott, Western Australia (lat. 19° 42′ 06″ S., long. 116° 49′ 48″ E.); 91 meters [A. H. Clark, 1909, 1911, 1912] (1, Berl. M., 3430). Pl. 64, fig. 178.

Bassett-Smith Bank; 16 meters [A. H. Clark, 1911] (1, B. M.).

Baudin Island, northwestern Australia; 15–27 meters; October 1890 [A. H. Clark, 1911, 1913] (1, B. M.).

Northwestern Australia; 16 meters [A. H. Clark, 1911]. This refers to the record from Bassett-Smith Bank given above.

Feather Reef, outer Great Barrier Reef, Queensland (between lat. 17° and 19° S.); between tides; Surg. Lieut. Comdr. W. E. J. Paradice, R. A. N. [H. L. Clark, 1926].

Surprise Shoal, outer Great Barrier Reef (about lat. 18° S.); 13 meters; Surg. Lieut. Comdr. W. E. J. Paradice, R. A. N. [H. L. Clark, 1926].

Alert; Port Denison, Queensland; 5–7 meters [Bell, 1882, 1884; P. H. Carpenter, 1883, 1888; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Albatross station 5163; Tawi Tawi group, Jolo (Sulu) Archipelago; Observation Island bearing N. 79° W., 6.7 miles distant (lat. 4° 59′ 10″ N., long. 119° 51′ 00″ E.); 51 meters; coral sand; February 24, 1908 (1, U.S.N.M., 35000).

Albatross station 5148; in the vicinity of Siasi; Sirun Island (N.) bearing S. 80° W., 3.8 miles distant (lat. 5° 35′ 40″ N., long. 120° 47′ 30″ E.); 31 meters; coral sand; February 16, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 34989).

Albatross station 5147; in the vicinity of Siasi; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908, 1909] (2, U.S.N.M., 35015).

Albatross station 5138; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 19° E., 2.5 miles distant (lat. 6° 06′ 00″ N., long. 120° 58′ 50″ E.); 35 meters; sand and coral; February 14, 1908 [A. H. Clark, 1908, 1909] (1, U.S.N.M., 34971).

Albatross station 5142; in the vicinity of Jolo; Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908, 1909] (2, U.S.N.M., 34983, 35031).

Dr. Th. Mortensen's Pacific expedition 1914–1916; off Jolo; about 27 meters; March 21, 1914 (1); about 29 meters; coral bottom; March 18, 1914 (1); about 36 meters; March 21, 1914 (2).

Siboga station 96; southeastern side of the pearl bank, Jolo Archipelago; 15 meters; lithothamnion bottom; June 27, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Sulu (Jolo) Sea; U. S. Exploring Expedition (1, U.S.N.M., 2701).

Sulu Sea; January, 1895 (1).

Albatross station 5254; Gulf of Davao; Linao Point bearing N. 44° E., 0.7 mile distant (lat. 7° 05′ 42″ N., long. 125° 39′ 42″ E.); 38 meters; sand and coral; May 18, 1908 [A. H. Clark, 1909] (4, U.S.N.M., 34982, 35002, 35018, 35071).

Albatross station 5249; Gulf of Davao; Lanang Point bearing N., 1 mile distant (lat. 7° 06′ 06″ N., long. 125° 40′ 08″ E.); 42 meters; coral and sand; May 18, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 34984, 35167).

Albatross station 5248; Gulf of Davao; Lanang Point bearing S. 33° W., 0.4 mile distant (lat. 7° 07″ 25″ N., long. 125° 40′ 24″ E.); 33 meters; coral bottom; May 18, 1908 (3, U.S.N.M., 34989).

Albatross; Mahinog, Camiguin Island, between Leyte and Mindanao; August 3, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35035).

Pandanon, near Bohol, Philippines; Prof. C. Semper [P. H. Carpenter, 1881, 1884, 1888].

Bantayan Reef, Cebu; Dr. L. E. Griffin [H. L. Clark, 1921] (26, M. C. Z., 379, 391, 392).

Port Galera, Mindoro; Dr. L. E. Griffin [H. L. Clark, 1921] (21, M. C. Z., 622, 623, 671–673).

Albatross; Philippines, 1908 [A. H. Clark, 1908].

Albatross station 5321; China Sea, in the vicinity of Formosa (Taiwan); Ibugos Island (S. end) bearing S. 89° W., 1.25 miles distant (lat. 20° 19′ 30″ N., long. 121° 51′ 15″ E.); 47 meters; white sand, coral, and broken shells; November 9, 1908 [A. H. Clark, 1911] (1, U.S.N.M., 34985).

Geographical range.—From Java to northern Australia and northward to the Philippines and Formosa.

Bathymetrical range.—Littoral and sublittoral, ranging from between tide marks down to 91 meters. The average of 25 depth records is 32 meters; but if the 12 records in which no depth is given are considered, the average is 23 meters.

History.—This species was first mentioned by Dr. P. H. Carpenter in 1881. In his original description of *Comantheria alternans* he said that its nearest ally is a species which was discovered by Professor Semper at Pandan[on], near Bohol, in the Philippine Islands, and he gave some of the characters by which the two may be distinguished.

In his description of *Comantheria grandicalyx* published in 1882 Carpenter said that he knew of only one other *Actinometra* with the same number and arrangement of the arm divisions as they occur in this type. This form was obtained by the *Challenger* at Banda, and is much smaller, with a thin flat centrodorsal.

Prof. F. Jeffrey Bell in 1882 gave a specific formula for a new species which he called *Antedon briareus* that had been collected by the *Alert* at Port Denison. This he described and figured in 1884.

In the *Challenger* report on the stalked crinoids published in 1884 Carpenter several times mentioned Semper's specimen from the Philippines. He called it here *Actinometra magnifica* and gave for it a specific formula.

In 1888 Carpenter placed Bell's *Antedon briareus* in the genus *Actinometra* and discussed it at considerable length. He made several references to *Actinometra magnifica* and included it in his key to the species of the *Parvicirra* group. The *Challenger* specimen from Banda which he had compared with *grandicalyx* in 1882 he described and figured under the name of *Actinometra divaricata.*

In 1891 Dr. Clemens Hartlaub recorded a specimen (as *divaricata*) from Amboina, and in 1894 Bell recorded another (as *Actinometra parvicirra*) from Baudin Island. In 1895 Prof. René Koehler recorded this species (as *divaricata*) from the Sunda Islands, and in another paper also from the Bay of Amboina.

In 1908 I recorded specimens from 3 *Albatross* stations in the Philippines and also from the Philippines without definite locality. In 1909 I recorded it from 6 *Albatross* stations in the Philippines and in another paper from a *Gazelle* station north of Port Walcott. In 1911 I recorded it from 2 more *Albatross* Philippine localities, and in an appendix to my paper on the crinoids of the Leyden Museum Dr. R. Horst recorded it from west Java.

In my report on the crinoids collected by the Hamburg southwest Australian expedition in 1905, which was published in 1911, I recorded a specimen presumably from the vicinity of Perth and gave Baudin Island and Bassett-Smith Bank as localities on the strength of specimens which I had examined at the British Museum in 1910. I also included west Java, although for some reason this had been omitted from my manuscript on the Leyden crinoids.

In my monograph on the crinoids of Australia published in 1911, and in the monograph on the crinoids of the Indian Ocean published in 1912, I relegated *divaricata* to the synonymy of *briareus*.

In 1913 I listed and gave notes on the specimens of this species in the British Museum, and in the same year Dr. August Reichensperger recorded and gave notes on 2 specimens from the Aru Islands.

In 1918 I recorded *briareus* from 10 *Siboga* stations in the Dutch East Indies and gave notes on the specimens.

In 1921 Dr. Hubert Lyman Clark recorded 28 specimens from Dr. Laurence E. Griffin's Philippine collection and described the colors in life.

COMANTHERIA ROTULA A. H. Clark

Plate 58, Figure 165

Comantheria rotula A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 23 (description; *Siboga* station 273); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 14 (no locality; characters of the specimen); Proc. Biol. Soc. Washington, vol. 29, 1916, p. 105 (comparison with *C. intermedia*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. IX (relationships with *C. intermedia*); p. 43 (in key; range); p. 45 (references; notes; stations 273, 282); p. 275 (listed); pl. 16, fig. 26.

Comanthus rotula H. L. Clark, Biol. Results Fishing Experiments F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, p. 15 (comparison with *C. perplexum*).

Comaster typica Gislén, Kungl. svenska Vetenskap. Akad. Handl., vol. 59, No. 4, 1919, p. 9 (Mjöberg's station 13); pl. 1, fig. 3.

Comaster typica form *minor* Gislén, Kungl. svenska Vetenskap. Akad. Handl., vol. 59, No. 4, 1919, p. 11.

Comanthus parvicirra α comasteripinna Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 50 (specimen from Mjöberg's station 13).

Diagnostic features.—A rather small species with 40 arms. The IIBr series are 4 (3+4) and the IIIBr series are 2; there is no further division. The centrodorsal is much reduced, irregularly circular or subpentagonal in shape, and almost always bears a few rudimentary cirri, although there may be none, in which case the edge of the centrodorsal is notched by obsolete cirrus sockets.

This species is most easily confused with *Comanthus timorensis*, which superficially it closely resembles.

Description.—The centrodorsal is greatly reduced.

There are usually a few weak cirri, though there may be none.

The IIBr series are 4 (3+4). The IIIBr series are 2. There is no further division.

The 40 arms are from 100 to 150 mm. long.

The dorsal surface of the animal is smooth, with comparatively little overlapping of the brachials. The rugged appearance characteristic of *C. briareus* is entirely absent.

Notes.—In the specimen from Mjöberg's station 13 the centrodorsal is pentagonal, with the angles interradial, 4 mm. in diameter. The margin is irregular and finely lobate, and the cirri arise from the depressions between the lobes. The center of the dorsal surface is slightly hollowed.

The cirri are IX, in a single incomplete row, from 0.5 to 2.5 mm. in length. They are indistinctly segmented and of very juvenile appearance, without any trace of dorsal spines or a terminal claw. The number of their segments is about 10.

The radials are almost or quite concealed. The IBr_1 are trapezoidal, proximally twice and distally three times as broad as long. They are entirely united laterally and, according to Gislén, are united to the IBr_2 by syzygy. The IBr_2 (axillaries) form right-angled triangles. The IIBr series are 4 (3+4). The $IIBr_1$, like all the ossicles immediately following axillaries, are interiorly united. The $IIBr_2$ are almost rectangular, but are longer exteriorly than interiorly. The $IIBr_3$ are narrow and bandlike, five times as broad as long. The lateral borders of the IIBr series are straight exteriorly and slightly concave interiorly. The IIIBr series are 2 or, according to Gislén, 2 (1+2). The 3 IVBr series present are 4(3+4).

The arms are more than 39, probably 42, in number. The anterior arms are about 105 mm. in length and the posterior are 80 mm. All of the arms except some of the posterior are provided with ambulacral grooves. The earlier brachials, about the first 7, are short and oblong, those following being irregularly wedge-shaped with produced distal ends.

Syzygies occur between brachials 3+4, again at about the tenth and fifteenth brachials, and distally at intervals of about 6 muscular articulations.

P_D is 15 mm. long and is composed of 35–40 segments which are more or less obscured by perisome. P_1 is 13 mm. in length and P_2 is 8 mm. P_3 to the fifteenth or nineteenth pinnule have about 25 segments which are as long as broad. These pinnules are thick and stout and have the proximal two-thirds very much distended by the sexual products. The distal 7 segments are provided with stout hooks, 3 on each segment. The other segments have smaller and more irregularly arranged spines. The twentieth and following pinnules are again more slender, 11 mm. long and composed of abut 25 segments which are very long, as much as three times as long as broad, at least in the proximal portion. The distal hooks are only developed on the last 3 segments. The earlier pinnules are provided with a short comb consisting of about 6 large teeth. Both among the genital and distal pinnules terminal combs with 6–10 teeth appear here and there.

The disk carries small calcareous granules. The mouth is marginal. The anal tube is central and inflated.

The color in alcohol is brown, with dorsally yellow spots on the division series and two yellow bands along the arms.

Six specimens collected by Dr. Laurence E. Griffin in the Philippines seem to belong to this species, although the cirri are better developed than usual. They may perhaps be best considered as intermediate between this species and the next, though nearer the former.

One has 39 arms which are 145 mm. long; the cirri are III, 14. Another has about 40 arms, with the cirri VIII, 14; a third has about 40 arms, with the cirri X; a fourth has about 40 arms. One of the remaining 2 has III cirri.

Remarks.—Gislén referred Mjöberg's specimen to *Comaster typica* on account of the construction of the centrodorsal and the development of the cirri. He said that as he had both a young and a mature specimen in which the centrodorsal and the cirri are of the *typica* form he did not hesitate to refer them to this species, although the number of the arms is smaller and the method of ramification different from the normal *typica*.

He added that perhaps it might be possible in this case to suggest a form *minor*.

His photograph of the specimen shows what appears to be a typical example of *Comantheria rotula*.

Localities.—*Siboga* station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands; pearl banks; 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1912, 1918] (11, U.S.N.M., E. 485; Amsterdam Mus.). Pl. 58, fig. 165.

Mjöberg's station 13; Broome, Western Australia; on the beach at low tide; July 27, 1911 [Gislén, 1919].

Port Galera, Mindoro, Philippines; Dr. Laurence E. Griffin (6, M. C. Z.).

Geographical range.—Known from Timor, the Aru Islands, northwestern Australia, and the Philippines.

Bathymetrical range.—Littoral and sublittoral; from between tide marks down to 27 (?54) meters.

History.—This species was originally described in 1912 from specimens from *Siboga* station 273. It was redescribed in greater detail and figured in 1918, when another specimen from *Siboga* station 282 was recorded.

In 1919 Dr. Torsten Gislén recorded a comatulid from Mjöberg's station 13 which he determined as *Comaster typica*, but which his figure shows to be this form.

COMANTHERIA WEBERI A. H. Clark

Plate 58, Figure 166

Comantheria weberi A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 22 (description; *Siboga* station 49*a*); vol. 29, 1916, pp. 105, 106 (comparison with *C. intermedia*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. IX (relationship with *C. intermedia*); p. 43 (in key; range); p. 46 (description; station 49*a*); p. 271 (listed); pl. 16, fig. 24.

Comanthus weberi H. L. Clark, Biol. Results Fishing Experiments F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, p. 15 (comparison with *C. perplexum*).

Diagnostic features.—A rather small species with 40 arms, the IIBr series being 4 (3+4) and the IIIBr series 2. The centrodorsal is well developed, thick discoidal, and many of the cirri are fully developed and functional, about 20 mm. long and composed of 19–20 segments. The outer cirrus segments bear a proximal tubercle dorsally in addition to the distal serrate transverse ridge, so that the dorsal profile is bidentate in lateral view.

Description.—The centrodorsal is discoidal, moderately thick, with the flat dorsal pole 4 mm. in diameter.

The cirri are XXXII, 19–20 (usually the latter), about 20 mm. long. The fifth and sixth or sixth and seventh segments are the longest, about half again as long as broad. The seventh or eighth (usually the latter) is a transition segment, strongly marked, and bearing a conspicuous dark band. The outer segments are nearly or quite twice as broad as long. The distal dorsal edge of the segments following the transition segment slowly becomes more and more prominent, forming a serrate transverse ridge which on the outer segments becomes subterminal, remaining as a narrow serrate ridge which may be more or less elevated in the center. On about the fifth segment following the transition segment a small low tubercle appears midway between this ridge and the proximal end of the segments which on the outer segments becomes pointed, so that in lateral view the dorsal profile of the segments is bidentate, as in *Oligometrides adeonae.* The longer proximal segments are slightly constricted centrally with prominent ends. Proximal to the transition segment the cirri are brownish yellow; beyond, white with a highly polished surface.

In the type specimen all the IIBr series are present, and all are 4 (3+4). All of the IIIBr series are present, and all are 2. There is no further division. The division series are moderately broad and are well rounded dorsally and moderately separated. The dorsal interradial perisome carries small scattered inconspicuous plates.

There are in the type exactly 40 arms which are 95 mm. long. All of the arms are grooved. The brachials are moderately overlapping.

Syzygies occur between brachials 3+4, 11+12 (more rarely 12+13), 16+17 (less commonly 17+18), and distally at intervals of 3 muscular articulations.

The mouth is submarginal and interradial.

Remarks.—Comantheria weberi is very closely related to *C. intermedia* of southern Japan, from which it differs in having somewhat stouter cirri with fewer segments, of which the longest are half again as long as broad instead of being only slightly longer than broad.

Locality.—Siboga station 49*a*; Sapeh Strait, between Sumbava and Komodo, Lesser Sunda Islands (lat. 8° 23′ 30″ S., long. 119° 04′ 36″ E.); 69 meters; coral and shells; April 14, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.). Pl. 58, fig. 166.

History.—This species is as yet only known from the single specimen secured by the *Siboga*.

COMANTHERIA PERPLEXUM (H. L. Clark)

Comanthus perplexum H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, June 2, 1916, p. 14 (description; off Ballina, N. S. W.; 27–28 fathoms); pl. 3, fig. 2.

Diagnostic features.—A rather small species with (in the type) 44 arms, the IIBr series being 4 (3+4) and the IIIBr series 2. The cirri, which resemble those of *weberi,* have 16–19 segments and are about 13 mm. long.

Description.—The centrodorsal is well developed, nearly 5 mm. in diameter, with the dorsal pole slightly concave. The cirri are arranged in a single marginal row.

There are about 15 cirrus sockets, 7 or 8 of which bear more or less developed cirri. The largest of these are about 13 mm. long and consist of 16–19 segments, of which the 3 or 4 preceding the penultimate carry very insignificant elevations or ridges on the proximal dorsal margin.

The radials are visible. The IBr_1 are broadly triangular and are not in contact interradially. The IIBr series are 4 (3+4), low, broad, smooth, and practically without synarthrial tubercles. The distal margins of the ossicles are distinct and slightly flaring, especially on the $IIBr_2$. The entire IIBr series is only 5 mm. long, but is nearly 4 mm. broad. The IIIBr series are 2, except on a single IIBr series, where one branch bears a IIIBr 4 (3+4) series and the other is undivided. There are 4 IVBr series present, all of which are 4 (3+4).

The 44 arms are about 100 mm. long, and consist of approximately 100 brachials beyond the last axillary. The brachials are quadrilateral, but except near the tip of the arm the side bearing the pinnule is much longer than the one opposite. The distal edges of the brachials are flaring, thickened, and minutely rough, but not spinulose.

The first syzygy is between brachials 3+4, the second from 10 to 15 brachials beyond, and the distal intersyzygial interval is, with remarkable uniformity, 5 muscular articulations.

The pinnules are rather slender. P_1 is about 17 mm. long and consists of 45 segments, of which the terminal 10 bear teeth. P_2 is shorter, with about 35 segments and a comb of 10 teeth. P_3 is remarkably short and weak, scarcely 5 mm. long and consists of only 18–20 segments. It has a well-marked comb of 7 segments. The following pinnules, which are without combs, gradually increase in length to 10 mm. or more and are composed of about 20 segments, none of which are conspicuously spinulose, though the terminal ones are more or less so; their basal segments are notably triangular.

The disk is lacking.

The color of the dry specimen is uniformly pale fawn, with the ventral surface of the arms and pinnules brownish black.

Remarks.—Dr. H. L. Clark said there is no doubt that this species is very near *C. briareus*, but after comparison with numerous specimens of the latter he was unwilling to refer it to that species.

He remarked that the color is naturally the most striking difference, but of course is the least significant. Nevertheless, it is noteworthy that all recorded specimens of *C. briareus* and all of the 30 specimens at hand (at the Museum of Comparative Zoölogy) are blackish brown, brownish black, or purplish black. One recorded from Western Australia by A. H. Clark has lighter lines on the arms.

Aside from the color, the flaring distal edges of the short elements of the division, series and of the brachials in *C. perplexum* are quite different from those of *C. briareus* while the smoothness of the brachials and pinnules is noticeable when contrasted with the rough arms of *C. briareus*.

Just why Doctor Clark compared this form with the very different *briareus*, from which it is at once distinguished by the small number of arms, the eversion of the distal edges of the elements of the division series, the smoothness of the arm bases, and the occurrence of functional cirri, it is difficult to see.

It is very closely allied to *weberi*, of which it appears to be the southern representative, but with which it may prove to be identical.

Locality.—Eleven miles south by east of Ballina, New South Wales; 49–51 meters; *Endeavour* [H. L. Clark, 1916].

History.—This species is as yet known only from the type specimen.

COMANTHERIA INTERMEDIA A. H. Clark

Plate 60, Figure 169; Plate 61, Figures 171, 172; Plate 65, Figure 182

Comantheria intermedia A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (*nomen nudum;* southern Japanese species; range and its significance); Proc. Biol. Soc. Washington, vol. 29, 1916, p. 105 (description; Sagami Bay, Japan, 0 to about 150 m.; relationships); Unstalked Crinoids of the *Siboga* Exped., 1918, p. IX (relationship with *C. weberi* and *C. rotula*); p. 43 (in key; range).

Diagnostic features.—The centrodorsal is thick discoidal and bears numerous cirri, of which only a few are well developed. These are slender, but long, usually between 23 and 25 mm. in length, and are composed of 20–28 (usually 24–26) segments. There are 31–48 (probably most commonly about 40) arms.

Description.—The centrodorsal is thick discoidal, from 7 to 9 mm. in basal diameter and from 4 to 6 mm. across the concave dorsal pole. The cirrus sockets are arranged in two and a partial third crowded alternating rows.

Usually there are only a few well-developed cirri, the majority being more or less rudimentary. They reach a maximum of XXXII; they have 20–28 (usually 24–26) segments, and are from 18 to 30 mm. (usually between 23 and 25 mm.) in length. The longest segments, in the proximal portion, are about one-third again as long as broad, and the distal segments, from about the eleventh onward, are about twice as broad as long; the transition from the one type to the other is rather abrupt. The short distal segments have the dorsal profile convex, the maximum height of this convexity being at first at the distal end of the segment but gradually moving proximally, so that the distal segments are provided with low blunt median tubercles. The opposing spine is transversely elongate. In general the cirri resemble those of *C. weberi*, but they are much more slender, much less curved distally, and are composed of a larger number of segments; the relative number of more or less rudimentary cirri is greater in this species than in *C. weberi*.

The arms are 31–48 (averaging 40) in number, from 130 to 180 mm. (averaging about 145 mm.) in length. The division series and brachials resemble exactly those of *C. weberi*.

Notes.—Of the 3 specimens from between Ito and Hatsushima Island the most developed has 48 arms. Two of the IIBr series are 2, the remaining 8 being 4 (3+4). Eighteen of the IIIBr series are 2, and 2 are 4 (3+4). The IVBr series are 4 (3+4), but are 2 if they follow IIIBr 4 (3+4) series. There are no fully developed cirri. The division series are comparatively broad and stout, approaching the conditions seen in *Comanthus solaster*.

The second specimen has 35 arms 140 mm. in length. One of the IIBr series is 2, the remaining 7 being 4 (3+4). Fourteen of the IIIBr series are 2, and 2 are 4 (3+4). The single IVBr series is 4 (3+4). The centrodorsal is 9 mm. in basal diameter, with a concave dorsal pole 6 mm. in diameter. Only one of the cirri is fully developed.

The third specimen has 31 arms 140 mm. long. One of the IIBr series is absent. The 9 present are all 4 (3+4). Ten of the IIIBr series are 2, and 2 are 4 (3+4). The division series are broad and nearly in lateral apposition, but are well rounded dorsally. The brachials are rather strongly overlapping. The centrodorsal is 7 mm. in basal diameter, thick discoidal, with a broad and slightly concave polar area 5 mm.

in diameter. Its sides are strongly inclined inward toward the dorsal pole. The cirrus sockets are arranged in 2 and a partial third irregular closely crowded alternating rows. The cirri are composed of 20–26 segments, and are from 18 to 23 mm. in length.

The larger of the 2 specimens from Ito has 38 arms 130 mm. long. All of the IIBr series are 4 (3+4). The 17 IIIBr series are all 2. The single IVBr series is 4 (3+4). There are no fully developed cirri.

The smaller specimen has 36 arms.

The specimen from Fukuura in about 150 meters is typical, with 40 arms. The 10 IIBr series are 4 (3+4), and the 20 IIIBr series are 2.

Of the 2 specimens from Fukuura without indication of depth, 1 is large, with 40 arms. Four of the IIIBr series are 4 (3+4). The cirri have 26–28 segments, and are from 25 to 30 mm. in length.

The other is very small, with 15 arms 23 mm. long. Four of the IIBr series are 4 (3+4), and 1 is 2. The cirri have 10 segments and are 5 mm. long.

One of the specimens from Sagami Bay is a finely developed example, with 46 arms 180 mm. long. The 10 IIBr series are all 4 (3+4). Nineteen of the IIIBr series are 2, and 1 is 4 (3+4). One of the IVBr series is 2, the remainder being 4 (3+4). The cirri are about XXXII, 20–24, from 20 to 25 mm. long.

Another specimen has 43 arms 140 mm. long. All of the IIBr series are 4 (3+4), all of the IIIBr series are 2, and the 3 IVBr series present are 4 (3+4). The centrodorsal is 9 mm. in basal diameter, low, with a concave dorsal pole 4 mm. in diameter. The cirri, of which only II remain, are composed of 25 segments and are 23 mm. long. Rudimentary cirri are very numerous.

The third specimen is typical, with 39 arms.

One of the 2 specimens from off Amoy has 48 arms 140 mm. long. All the IIBr series are 4 (3+4) and all the IIIBr series are 2; the IVBr series are 4 (3+4). The division series are broad, but are rather strongly convex dorsally and are laterally separated by a narrow perisomic strip. The brachials have the distal edge produced and overlapping and armed with fine spines. The centrodorsal is 4 mm. in diameter; the dorsal pole is strongly concave. The cirri are very numerous and well developed, XLIII, 23–28 (usually 26), up to 30 mm. in length. The longest earlier segments are usually slightly longer than broad, varying from about as long as broad to one-third again as long as broad. The cirri are rather slender.

The other specimen from Amoy has 42 arms 125 mm. long. The 10 IIBr series are 4 (3+4); of the 19 IIIBr series, 18 are 2 and 1 is 4 (3+4). The following series are 4 (3+4). The division series are rather broad, well rounded dorsally, and laterally separated by narrow strips of perisome. The cirri are XXVI, 22–24, up to 23 mm. in length. The tenth or eleventh is a transition segment.

Localities.—Sagami Bay, southern Japan; between Ito and Hatsushima Island; about 150 meters; Doctor Haberer, March, 1903; original Nos. 4201, 4205, and 4217 [A. H. Clark, 1915, 1916, 1918] (3, U.S.N.M., 35756; Munich Mus.). Pl. 60, fig. 169.

Ito, Sagami Bay; Doctor Haberer, 1904 [A. H. Clark, 1915, 1916, 1918] (2, Munich Mus.).

Fukuura, Sagami Bay; about 150 meters; Doctor Haberer, March 1–12, 1903 [A. H. Clark, 1915, 1916, 1918] (1, Munich Mus.).

Fukuura, Sagami Bay; Doctor Haberer, February 10–20, 1903; original Nos. 4117, 4146 [A. H. Clark, 1915, 1916, 1918] (2, U.S.N.M., 35776; Munich Mus.).

Sagami Bay; Doctor Haberer, April, 1903; original Nos. 9307, 9308, and 9309 [A. H. Clark, 1915, 1916, 1918] (3, U.S.N.M., 35777; Munich Mus.). Pl. 61, fig. 172; pl. 65, fig. 182.

Off Amoy, China (lat. 24° 06′ N., long. 118° 25′ E.); 36 meters; bottom temperature 76° F.; Capt. H. Christiansen, S. S. *Nordiske*, August 10, 1912 (2). Pl. 61, fig. 171.

Geographical range.—From Sagami Bay, southern Japan, southward to Amoy, China.

Bathymetrical range.—Apparently from shallow water down to about 150 meters.

History.—This species was first mentioned (as a *nomen nudum*) and its range given in 1915. In the following year it was described in detail on the basis of the specimens from southern Japan. In 1918 it was inserted in the key to the species of the genus *Comantheria* in the report on the unstalked crinoids of the *Siboga* expedition.

COMANTHERIA TAVIANA (A. H. Clark)

Plate 63, figs. 176, 177

[See also vol. 1, pt. 2, fig. 263 (arm and pinnules), p. 207]

Alecto multifida A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 87 (last reference to this name, but not those preceding).

Phanogenia carpenteri A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 392 (*Albatross* station 5153; notes).

Comaster multifida A. H. Clark, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 171 (near Port Dos Amigos, Tawi Tawi).

Comaster taviana A. H. Clark, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 172 (detailed description; *Albatross* station 5153); Crinoids of the Indian Ocean, 1912, p. 85 (description; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 37 (in key; range).

Diagnostic features.—Terminal combs occur on most of the genital pinnules and at intervals on those in the distal portion of the arms. There are 40 (36) arms. The cirri are from 13 to 15 mm. long and are composed of 16–18 segments, of which the outer have dorsally a proximal tubercle as well as a produced distal edge or a distal tubercle, so that the dorsal profile is bidentate.

Description.—The centrodorsal is discoidal, broad, with the broad bare polar area flat, 5 mm. in diameter. The cirrus sockets are arranged in a single crowded and somewhat irregular marginal row.

The cirri are XX–XXII, 16–18, moderately slender, from 13 to 15 mm. in length. The first 2 segments are about twice as broad as long, the third is slightly longer than broad, the fourth-seventh or -eighth are half again as long as broad, and those following gradually decrease in length, so that the terminal 7 or 8 are about one-third again as broad as long. The ninth is a transition segment, in the proximal three-fourths rounded in cross section and with a dull surface like the segments preceding, but with a polished surface like that of the succeeding segments in the distal fourth. Following the transition segment, the segments become rather strongly compressed laterally, so that in a lateral view the cirrus appears to thicken from this point onward. The transition and following segments have the distal dorsal edge produced, this production rapidly becoming more sharply rounded and soon angled, the segments at the same time becoming distally more carinate dorsally, so that the later segments are provided with a small but sharp subterminal tubercle. In addition the segments from the eleventh or twelfth onward have, just before their middle, a second, more rounded, median dorsal tubercle which is not quite so high as that in the distal portion. The cirri of this species present, therefore, much the same appearance as those of *Oligometrides adeonae.* The opposing spine is represented by a small median tubercle arising from the entire dorsal surface of the penultimate segment; in lateral view the apex usually forms slightly more than a right angle, though occasionally it is sharper. The terminal claw is somewhat longer than the penultimate segment, stout basally but becoming more slender distally, and is moderately curved.

The ends of the basal rays are visible as small tubercles in the angles of the calyx.

Of the radials only a small portion is visible in the angles of the calyx over the ends of the basal rays. The IBr_1 are very short and broad, more or less, indeed sometimes wholly, concealed by the centrodorsal; their lateral edges are just in contact basally, but diverge distally. The IBr_2 (axillaries) are broadly pentagonal, almost triangular, twice as broad as long, or even somewhat broader. The IIBr series are 4 (3+4). The IIIBr series are 2. The IVBr series are 2, but are irregular in their occurrence. The division series are free laterally though not widely separated; they are rounded dorsally but not especially convex.

The 36 arms are about 100 mm. long. The first brachials are short, wedge-shaped, almost wholly united interiorly, twice as broad as the interior length or slightly broader. The second brachials are similar, but slightly larger. The first syzygial pair (composed of brachials 3+4) is not quite so long as broad. The next 2 brachials are oblong, about twice as broad as long, after which the brachials become triangular, about half again as broad as long, after the end of the proximal third of the arm gradually becoming wedge-shaped, and in the terminal portion wedge-shaped and about as long as broad. The fourth and following brachials have strongly produced and finely spinous distal ends. The arms increase gradually in width up to the tenth brachial, thence tapering very gradually distally.

Syzygies occur between brachials 3+4, again usually between brachials 13+14, and distally at intervals of 4, more rarely 5, muscular articulations.

P_1 is 10 mm. long, slender, composed of 35 segments, of which the first is short oblong, about two and one-half times as broad as long, and those following are rhombic, at first nearly twice as broad as long but gradually becoming longer and about as long as broad after the sixth. The second and following segments have the corners cut away, this feature gradually decreasing distally and disappearing entirely after about the twelfth segment. From the second to the tenth or eleventh the segments have long single or double spines projecting vertically from the dorsal surface which at first are equal to half the width of the segment in height, but slowly decrease in length distally. The terminal comb is short and very prominent, beginning abruptly, and consisting of 6 or 7 teeth which are subequal, triangular, slightly longer than broad, rather strongly recurved, rather longer than the width of the segments that bear them, with their bases in apposition. P_2 is 5 mm. long and is composed of 20 segments, resembling P_1 but weaker and more slender. P_3 is 3.5 mm. long with 15 segments, resembling P_2. P_4 and the following pinnules are stouter than those preceding. They are 6 mm. long and are composed of about 20 segments, of which the first 2 are short and the remainder about as long as broad, becoming longer than broad distally. The distal ends of the segments are spinous and strongly overlapping, and the more proximal segments are usually furnished with more or less prominent dorsal spines in addition. Distally the pinnules gradually become shorter and more slender, the distal pinnules being 6 mm. long, very slender, composed of about 20 segments, of which the first 2 are short, the third is longer than broad, and the remainder are elongated with slightly expanded ends, becoming about twice as long as broad distally. Terminal combs usually occur on most of the genital pinnules, and at intervals on those in the distal portion of the arms.

The disk is covered with rather coarse papillae. The mouth is submarginal and the anus subcentral.

Locality.—*Albatross* station 5153; Tawi Tawi group, Sulu (Jolo) Archipelago; Tocanhi Point, bearing S. 27° E., 2.1 miles distant (lat. 5° 18′ 10″ N., long. 120° 02′ 55″ E.); 89 meters; coral sand and shells; February 19, 1908 [A. H. Clark, 1909, 1911, 1912, 1918] (1, U.S.N.M., 35243). Pl. 63, figs. 176, 177.

History.—This specimen was originally identified as representing Müller's *Alecto multifida* and was so referred to in 1909. The identification was made by means of the keys in the *Challenger* report, where, curiously enough, it runs nicely to *Actinometra multifida*, which was placed by Carpenter in the *Parvicirra* group.

In another paper published in 1909 it was mentioned as *Phanogenia carpenteri*, and the locality at which it was taken, together with notes on its arm division, were given.

The name *Comaster carpenteri* had been proposed in 1908 as a new name with the following explanation:

> Doctor Carpenter in 1888 described a species of *Comaster* as *Actinometra multifida*, referring the name to Johannes Müller; but Müller, according to his own statement, proposed the name *multifida* merely as a substitute for Lamarck's *multiradiata*. His idea was that, two quite different species having been called *multiradiata*—one by Lamarck and one by Goldfuss, but Lamarck's description being quite worthless, whereas Goldfuss's is accompanied by an excellent figure—the name should hold for the form with the recognizable diagnosis, so he restricted it to Goldfuss's form. Subsequently he examined Lamarck's original types, and from them drew up his diagnosis of *multifida*. Now, thanks to Doctor Carpenter's investigations, we know what Lamarck's *multiradiata* really is, and (as it is the same as the Linnaean and Retzian *Asterias multiradiata*) of course the specific name *multiradiata* must be retained for it. Doctor Carpenter realized this, but he resurrected *multifida* for a specimen which was among Lamarck's types, and differed both from the *multiradiata* of Lamarck and the *multiradiata* of Goldfuss; but *multifida* is a pure synonym of *multiradiata* Lamarck and can not be used for any other species. The form may be renamed *Comaster carpenteri*.

There are several errors in this reasoning. Lamarck's *Comatula multiradiata* is not the same as Linné's *Asterias multiradiata*. Müller's *Alecto multifida* is a new name for Lamarck's *Comatula multiradiata*, and the original description of *multifida* was based on notes taken from one of Lamarck's specimens by Troschel.

Carpenter's *Actinometra multifida* is Müller's *Alecto multifida*, and Carpenter's conception of this form was based on his personal study of Müller's type specimen at Paris.

Therefore *Comaster carpenteri* has no standing, being simply a new name for *Actinometra multifida* of Carpenter, which is the same as the *Alecto multifida* of Müller, which last is simply Lamarck's *Comatula multiradiata* (not identical with the *Asterias multiradiata* of Linné) reidentified.

In 1910 I examined the type of Müller's *Alecto multifida* at Paris and found it to be quite a different thing from what I had supposed. It was, indeed, wholly different from the specimen which I had regarded as representing *multifida*. This last I therefore described in 1911 as a new form under the name of *Comaster taviana*.

COMANTHERIA GRANDICALYX (P. H. Carpenter)

Plate 59, Figures 167, 168; Plate 60, Figure 170

Actinometra grandicalyx P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 520 (description; Canton, China); Proc. Zool. Soc. London, 1882, 1883, p. 747 (listed); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 59, 330, 367, 382 (discussion).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (identity); Crinoids of the Indian Ocean, 1912, p. 36 (of P. H. Carpenter, 1888=*Comantheria grandicalyx*); p. 39 (of Bell, 1899=*Comanthus bennetti*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 76 (of Bell, 1899=*Comanthus bennetti*).

Comaster grandicalyx A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia grandicalyx A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus grandicalyx A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comantheria grandicalyx A. H. Clark, Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (identity); p. 7 (Canton; detailed description of the type; Fuchow; notes); Crinoids of the Indian Ocean, 1912, p. 36 (identity); p. 90 (synonymy; Canton; redescription of the type); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43 (in key; range).

Comantheria imbricata (part) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 91 (Futschau).

Diagnostic features.—The centrodorsal is large, low hemispherical, and bears very numerous large and robust cirri with usually 24 segments which reach 25 mm. in length and are about one-third as long as the arms. The arms are 47–48 in number. The division series are broad and massive, and their component elements have smooth distal edges. The brachials have overlapping, but not especially produced, distal edges.

Description.—The centrodorsal is large, low hemispherical, 9 or 10 mm. broad at the base. The dorsal pole is 4 mm. in diameter and is concave in the center.

The cirri are XL–L, 23–26 (usually 24), 25 mm. in length. The basal segments are short, the fourth is about as long as broad, and the eighth, ninth, or tenth, which is the longest, is slightly longer than broad. From this point onward the segments decrease in length, and the outermost 10 or 11 are rather abruptly shorter than those preceding, about twice as broad as long, with a highly polished surface and low, obscure, broad median dorsal tubercles which become better developed distally. The opposing spine is quite distinct.

The IBr_1 are partially concealed by the centrodorsal. The IBr_2 (axillaries) are relatively long, almost triangular, with a sharp distal angle. The IIBr series are all 4 (3+4), the IIIBr series are all 2, and the IVBr series are all 4 (3+4). The first segments following each axillary are closely united internally and are somewhat wedge-shaped, the outer side being the longer.

The 47+ arms are about 100 mm. long. The second brachials are somewhat shorter and more nearly oblong than the first. The first syzygial pair (composed of brachials 3+4) and the next 3 or 4 brachials are also nearly oblong. The succeeding brachials are rather sharply wedge-shaped, nearly twice as broad as long, and overlapping, becoming shorter and less obliquely wedge-shaped after about the thirtieth.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 21+22, and distally at intervals of from 4 to 10, usually 4 or 5, muscular articulations.

P_D is slender, except just at the base, and is very long, reaching almost 25 mm. The pinnule on the IVBr series, when present, is somewhat shorter, and P_1 is shorter still, though more than 15 mm. in length. P_1 is longer on arms arising from a IIIBr series than it is on arms arising from a IVBr series. The pinnules following decrease in length to the third or fourth, which are not especially small. The succeeding pinnules gradually increase in length, and are also stouter, with larger segments, becoming more slender again when the brachials decrease in size. The second-third or -fifth segments of the pinnules borne by the fourth and 5 or 6 following brachials have spinous rounded distal processes, suggesting the condition which is carried to an extreme in *Comanthina belli.* These are much more distinct on some arms than on others. The lowest pinnules have a tolerably well marked comb which gradually decreases in size and disappears after the seventh or eighth brachial. The comb consists of 12–15 (usually 14) teeth. These are low and rounded, arising gradually and gradually becoming obsolete distally.

The disk is from 30 to 35 mm. in diameter. The mouth is radial. All of the arms are grooved.

As described by Carpenter the color of the type specimen, preserved in alcohol, is blackish brown, the skeleton somewhat redder, with a broad white stripe along the mediodorsal line which starts from the centrodorsal and extends outward on to the arms. When I examined this specimen it had faded still further, so that the ground color was grayish brown.

Notes.—Consul Siemssen's specimen from Fuchow closely resembles the type, but is slightly smaller and less robust.

The centrodorsal is large, with a strongly concave dorsal pole 3 mm. in diameter.

The cirri resemble in general those of *Comanthus bennetti.* They are 25 mm. long and are composed of 23–25 segments, of which the first 3 are very short, the fifth is about as long as broad, and the seventh-tenth are the longest, slightly longer, though scarcely so much as one-third longer, than broad. The following segments decrease very slowly in length until they become about as long as broad, or slightly broader than long. But the terminal 9 or 10 are abruptly shorter than those preceding, twice as broad as long, or even broader. These short distal segments, as in the type specimen, have a polished surface in contrast to those preceding, which have a dull surface, and they bear dorsally a low, rounded, and obscure hump which becomes more evident toward the end of the cirri.

All of the IIBr series are 4 (3+4). Of the IIIBr series 2 are 4 (3+4) and 18 are 2. Of the IVBr series 6 are 4 (3+4) and 2 are 2. The division series are rather broad, though not in lateral contact, and are well rounded dorsally.

The 48 arms are about 110 mm. long.

The disk is 30 mm. in diameter. The color in alcohol is a uniform deep yellow brown.

Localities.—Canton, China; Werner [P. H. Carpenter, 1882, 1888; A. H. Clark, 1912, 1918] (1, H. M.). Pl. 59, figs. 167, 168.

Fuchow, Province of Fokien, China; Consul G. Siemssen, April 4, 1906 [A. H. Clark, 1912] (1, H. M.). Pl. 60, fig. 170.

Fuchow, China [A. H. Clark, 1912] (1, H. M.).

History.—This species was originally described in 1882 from a specimen from Canton in the Hamburg Museum by Dr. P. H. Carpenter. In 1912 I recorded 2 other specimens from Fuchow in the same museum.

COMANTHERIA IMBRICATA (A. H. Clark)

Plate 29, Figure 87; Plate 62, Figure 173

[See also vol. 1, pt. 2, fig. 246 (arm), p. 199]

Comaster imbricata A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 306 (description; 35° 06′ N., 139° 42′ E., 50 fathoms); p. 506 (listed).

Comanthus imbricata A. H. Clark, Zool. Anzeiger, vol. 34, Nos. 11–12, 1909, p. 366 (compared with *C. briareus*).

Comanthus (Comanthus) rotalaria (part) A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 145 (off the Goto Is.).

Comantheria imbricata A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 22 (compared with *C. weberi*); Crinoids of the Indian Ocean, 1912, p. 91 (synonymy; southern Japan, and off the Goto Islands; but not the specimen from Futschau, which is *C. grandicalyx*); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (eastern Asia; probably Korean Straits); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43 (in key; range).

Comantheria grandicalyx Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 39 (Bock's station 52; notes); figs. 30, 31, p. 44; Zool. Bidrag från Uppsala, vol. 9, 1924, p. 77 (syzygies); fig. 65, p. 75 (syzygial faces).

Comantheria grandicalyx var. *flagellipinna* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 41 (Bock's stations 51, 92; notes); p. 182 (Bock's station 51A, but not 51); fig. 32, p. 44.

Diagnostic features.—The centrodorsal is large, thick discoidal, and bears a moderate number of fairly stout cirri with usually about 25 (22–30) segments which are mostly about 25 mm. (20–30 mm.) in length, and are about one-third of the arm length. The arms are 30–68 in number. The division series are narrow and strongly convex dorsally, and their component ossicles have everted and spinous distal edges. The brachials have strongly produced and spinous overlapping distal edges.

Description.—The centrodorsal is rather large, thick discoidal, with the bare polar area flat, 5 mm. in diameter. The cirrus sockets are arranged in a marginal row with a more or less complete second row alternating with it.

The cirri are XXV, 22–30 (usually about 25), from 20 to 30 mm. (mostly about 25 mm.) in length, moderately stout and of uniform size throughout. The first segment is about twice as broad as long, the fourth is about as long as broad, the fifth-eighth or -ninth are about as long as broad or slightly longer than broad, and the remainder are about one-third again as broad as long. The sixth and following segments have the distal dorsal edge produced into a low serrate transverse ridge which moves proximally on the succeeding segments, soon attaining a median position and appearing as a small spine in lateral view and a serrate crescentic or flattened ridge in end view. The opposing spine is a short transversely linear median ridge which is about as high as the ridge on the preceding segment and is straight or slightly concave in profile. The terminal claw is stout, moderately curved, about equal to the penultimate segment in length.

The ends of the basal rays are just visible as very small tubercles in the interradial angles of the calyx.

The radials are just visible over the ends of the basal rays in the angles of the calyx. The IBr_1 are very short and bandlike, united in the proximal two-thirds but widely diverging distally. The IBr_2 (axillaries) are very broadly pentagonal or almost triangular, twice as broad as long, widely separated laterally. The IIBr series are 4 (3+4) (in the type specimen two of them are 2). The IIIBr series are 2 (in the type specimen 2 of the 8 are 4 [3+4]). The first ossicles following each axillary are almost entirely united interiorly. The division series are strongly rounded dorsally and laterally and entirely free laterally.

The arms are about 30 in number, 90 mm. long. The first 2 brachials are subequal, slightly wedge-shaped, twice as broad as long. The first syzygial pair (composed of brachials 3+4) is oblong, from half again to twice as broad as long. The next 2 or 3 brachials are approximately oblong, twice as broad as long, and those following become nearly or quite triangular, not quite so long as broad, and in the distal half of the arm wedge-shaped, twice as broad as long, and slightly longer terminally. The elements of the division series and all the brachials have strongly produced distal ends.

Syzygies occur between brachials 3+4, again in the vicinity of the eleventh or twelfth brachial, and distally at intervals of usually 4 muscular articulations.

The disk is 15 mm. in diameter and naked. The mouth is radial and marginal. The anal area is very large. The anal tube is central.

P_D is about 16 mm. long, comparatively slender and but little enlarged basally. The terminal comb is short, with 6 or 7 moderately large rounded triangular teeth. P_P is similar, nearly as long, and only slightly less stout basally. P_1 is similar to P_P. P_2 and P_3 are very small and weak, only 5 mm. long. P_4 and the following pinnules are about 7 mm. long, stouter than P_3 and bearing long gonads. The distal pinnules are slender, about 9 mm. long. All the pinnules have the basal segments with rather prominent finely spinous distal ends, especially on the dorsal side.

The color in alcohol is brownish yellow, the division series and arm bases with a broad dark lateral line, the cirri lighter with occasional dark bands.

Notes.—Suensson's specimen from eastern Asia has 36 arms which are 125 mm. long. The IIBr series are all 4 (3+4). Of the IIIBr series, 8 are 2 and 2 are 4 (3+4). The cirri are composed of 25–26 segments and are from 20 to 25 mm. long.

Schönau's specimen from off the Goto Islands is a young example just attaining the multibrachiate condition. There are 7 IIBr series present, all 4 (3+4), and there is one IIIBr series of 2.

Doflein's specimen from Aburatsubo is larger than the type, but otherwise resembles it in every particular. The dorsal pole of the thick discoidal centrodorsal is concave, 4 mm. in diameter. The cirri are stout, with 29–31 segments, and are 35 mm. long. The division series are narrow, strongly convex, and well separated. The IIBr series are all 4 (3+4). The IIIBr series are all 2. The distal edges of the ossicles of the division series and of the brachials are strongly everted. The 33 arms are 150 mm. long.

The specimen from Bock's station 51A has the centrodorsal 12 mm. in diameter at the base, 9 mm. across the bare dorsal pole, and 3 mm. high.

The cirri are LI, 28–33, form 27 to 35 mm. in length, and are arranged in 2 or 3 rows. The first segment is twice as broad as long, the second-eleventh are about as long as broad, a little wider at the ends than in the middle, and the twelfth-fourteenth are somewhat longer than broad. There is a transition segment at about the twentieth. The dorsal spines are weak, but rather distinct. The spines on the distal segments are pointed. The terminal claw is curved, and is half again as long as the penultimate segment.

The IBr_2 (axillary) is twice as broad as long, with the distal angle acute. The IIBr series are 4 (3+4). The 20 IIIBr series are 2. The 24 IVBr series are 4 (3+4). The $IIBr_1$ are almost entirely free interiorly.

The 64 arms are from 140 to 190 mm. in length and are dimorphic. The width of the brachials 50 mm. from the base of the arms is 1.8 mm., and distally it is 0.6 mm. There are 19–23 brachials for each 10 mm., or 15–17 if the syzygial pairs are counted as units. The brachials are "very swollen, thick, and coarse."

The second syzygy is from between brachials 22+23 to between brachials 24+25, and the third is from between brachials 28+29 to between brachials 30+31. The distal intersyzygial interval is 4 (to 5) muscular articulations.

P_D is from 30 to 33 mm. in length and is composed of 75–80 segments. It has a very indistinct comb of about 12 teeth which is partly hidden by perisome. The tip of the pinnule is smooth. The pinnule on the IVBr series is similar to P_D and, like it, has a comb composed of 12 teeth. P_1 is about 23 mm. long and has a comb composed of 18 teeth which are more strongly developed than those of the combs of the pinnules preceding. P_2 is 16 mm. long, with about 40 segments. Its comb is composed of 6 teeth. The tip of the pinnule is smooth. P_3 is shorter; its comb is composed of some few small teeth. P_4 is 6 mm. long, with about 25 segments, and bears no comb. The genital pinnules are 12 mm. long. The distal pinnules are 14 mm. long, with about 30 segments, which are half again as long as broad. The dorsal hooks are indistinct.

The disk is 38 mm. in diameter. The color as preserved is reddish yellow.

In one of the 2 specimens from Bock's station 52 the centrodorsal is 10 mm. in diameter at the base. The free dorsal pole is very concave, 6 mm. in diameter. The cirri are arranged in about 3 closely crowded rows.

The cirri are about LXXV, 30–31, from 29 to 34 mm. long. The dorsal cirri are smaller and shorter, being 25 mm. in length and composed of 26 segments. The first 5 cirrus segments range from broader than long to about as long as broad. The sixth-eleventh or -fourteenth are a little longer than broad. The following segments decrease in length, and are from one-third again to twice as broad as long. From the twentieth or twenty-fifth segment onward there is a very weak and indistinct dorsal spine. The opposing spine is a little stronger than the spines on the preceding segments. The terminal claw is rather stout and is somewhat longer than the penultimate segment.

The IBr_1 are almost concealed by the centrodorsal. The IBr_2 (axillaries) are low pentagonal, three times as broad as long, with the distal margins concave. The IIBr series are 4 (3+4). The IIIBr series are 2. The IVBr series are 4 (3+4). The $IIBr_1$ are interiorly united basally. Both elements of the IIIBr series, and sometimes also the first 2 brachials, are interiorly united. There is a weak synarthrial tubercle on the articulation between the elements of the IIIBr series. The division series are smooth, broad, and tolerably flat. The disk only appears slightly between the inner sides of the IIBr series.

The 58 arms are 120 mm. long. The brachials are very short, from three to four times as broad as long. The width of the arms in the middle is 2.2 mm. There are 16 brachials for each 10 mm., or 13 if the syzygial pairs are counted as units. All of the arms are grooved.

Syzygies occur (as an example) between brachials 3+4, 16+17, and 22+23, and distally at intervals of 4 muscular articulations.

P_D is 30 mm. long and is composed of about 60 segments. Its comb is composed of about 20 rather thin and low teeth which rise to a height equal to about half the width of the segments. The teeth extend from the thirty-seventh to the fifty-eighth segment, the terminal segments being without them. The pinnule on the IVBr series, or P_1, is from 22 to 28 mm. long and carries a comb of about 20 teeth. P_2 is about 15 mm. long and has a comb with about 15 teeth. P_3 is 11 mm. long, and its comb has only 6 teeth. If the pinnule on the IVBr series is lacking, there are only 4 pinnules (P_D to P_3) with teeth. P_6 is 9.5 mm. long. The genital pinnules are 14 mm. long. The distal pinnules are 11 mm. long with 25 segments, of which the last 3 are provided with small dorsal hooks. The proximal pinnules have the first 5–12 segments provided with small prominences and are partly webbed with perisome. On about 10 of the posterior arms, from 25 to 30 pairs of pinnules are without ambulacral furrows.

The disk is 40 mm. in diameter. There are no calcareous granules or papillae. The mouth is marginal and the anal funnel central, 14 mm. high, and sharply set off from the anal interradius.

The color is brown, with a somewhat lighter median line on the dorsal surface of the arms.

In the second specimen from Bock's station 52 the dorsal pole of the centrodorsal is slightly concave, 9 mm. in diameter.

The cirri are about LXX, 27–30, from 25 to 30 mm. long.

The 10 IIBr series are 4 (3+4). The 20 IIIBr series are 2. The 26 IVBr series are 4 (3+4). The 2 VBr series are 2.

The 68 arms are 130 mm. or shorter and resemble those of the other specimen. All of the arms are grooved.

P_D is more than 35 mm. long and is composed of more than 80 segments. Teeth are developed from the fortieth or fifty-fifth to the seventy-fifth segments, they being best developed at about the sixtieth segment. The succeeding pinnules to P_3 decrease in length, but all are provided with combs.

The disk is 42 mm. in diameter, and the anal funnel is 17 mm. high.

In one of the specimens from Bock's station 62 the centrodorsal is 11 mm. in diameter, the free dorsal pole being 7 mm. in diameter.

The cirri are about L, 27–32, from 24 to 29 mm. long. A transition segment occurs somewhere between the thirteenth and the eighteenth.

The IIBr series are 4 (3+4). The IIIBr series are 2. One of the IVBr series is 2, all the rest being 4 (3+4). The single VBr series is 2.

The 68 arms are from 90 to 110 mm. long. There are 19 brachials for each 10 mm. of arm length.

P_D is 32 mm. long, with about 65 segments. Its comb is composed of 10–17 indistinct teeth. The pinnule on the IVBr series is 28 mm. long, with about 55 segments, of which 12 bear small teeth. P_2 is 12 mm. long, with 31 segments, of which 8 bear teeth. P_3 is 8 mm. long, with 25 segments, of which 5 bear teeth. P_4 is 6 mm. long and carries no comb. The genital pinnules are 8.5 mm. long, with about 20 segments. The distal pinnules are 11 mm. long, with about 25 segments.

The disk is 33 mm. in diameter. The mouth is adradial and marginal. The anal tube is somewhat swollen, but is well differentiated from the disk; it is 12 mm. high.

The color as preserved is brown orange to gray brown.

Remarks.—The 5 specimens from the Bonin Islands referred to *Comantheria grandicalyx* by Gislén seem really to represent this species.

Gislén mentions "very weak and indistinct" and "weak but distinct" dorsal spines. These are characteristic of *C. imbricata*, but in *C. grandicalyx* the cirri bear merely low rounded and obscure dorsal humps, much as is the case in *Comanthus bennetti.*

The only mention he makes of the distal ends of the brachials is in connection with the specimen from Bock's station 51 in which they are "very swollen, thick, and coarse." This would apply perfectly well to *C. imbricata*, but would scarcely apply to *C. grandicalyx*, in which the brachials are almost smooth, with the distal ends only slightly produced.

It is quite evident that Gislén was led astray by my key to the species of *Comantheria* in the *Siboga* report. In this key the chief emphasis was placed on the assumption that the leading feature of *C. grandicalyx* is the possession of broad division series which are nearly or quite in lateral apposition and of which the component ossicles have smooth distal ends, while in *C. imbricata* the division series are narrow and strongly convex dorsally and the component ossicles have everted and spinous distal ends.

In this genus, as is shown by a study of a long series of specimens of *C. briareus*, the division series are ordinarily narrow and strongly rounded in the young, but broaden with age, so that in highly developed specimens they are usually very broad, sometimes almost in lateral contact, and are only moderately convex dorsally.

It is only fair to Gislén to say that I made exactly the same mistake in my monograph on the crinoids of the Indian Ocean. The locality Futschau given under *C. imbricata* is based upon 2 specimens of *C. grandicalyx*.

The specimens from Bock's stations 51 and 62 Gislén differentiated as *C. grandicalyx* var. *flagellipinna*, saying that they are distinguished from typical *grandicalyx* by the nearly smooth P_D, by the very short brachials, by a more slender habitus, and by the trifling size of the disk when compared with the length of the arms.

The apparent smoothness of P_D is undoubtedly due to the fact that these specimens were originally preserved in formalin. The length of the brachials is not especially significant in this group, and the relative size of the disk is very variable.

Localities.—Eastern Asia (probably the Korean Straits); Captain Suensson, April 19, 1911 [A. H. Clark, 1913] (1, C. M.).

Off the Goto Islands, near Nagasaki (lat. 33° 08′ N., long. 129° 20′ E.); 65 meters; Schönau, March 14, 1890 [A. H. Clark, 1909] (1, C. M.). Pl. 29, fig. 87.

Sagami Bay (lat. 35° 06′ N., long. 139° 42′ E.); 91 meters; Alan Owston, April 24, 1902; original No. 7216 [A. H. Clark, 1908] (1, U.S.N.M., 22697). Pl. 62, fig. 173.

Aburatsubo; Prof. Franz Doflein, 1904; original No. 294 (1, Munich Mus.).

Dr. Sixten Bock's expedition to Japan station 51A; Bonin Islands; in the Channel; 64 meters; August 3, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 52; Bonin Islands; Taki-no-ura Channel; 55–73 meters; August 3–4, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 62; Bonin Islands; in the channel between Chichijima and Anojima; 20 meters; August 1914 [Gislén, 1922].

Geographical range.—Southern Japan from the Korean Straits to Sagami Bay, and the Bonin Islands.

Bathymetrical range.—Sublittoral; from 20 to 91 meters. The average of 5 records is 61 meters.

History.—This species was originally described in 1908 from a single specimen collected in Sagami Bay by Mr. Alan Owston in his yacht, the *Golden Hind*.

In 1909 in a paper on the crinoids in the Zoological Museum at Copenhagen I recorded a specimen of *Comanthus parvicirra* ("*rotalaria*") from off the Goto Islands. But I soon found that this was in reality a young individual of *Comantheria imbricata*, and in my monograph on the crinoids of the Indian Ocean published in 1912 I mentioned among the localities given for *C. imbricata* "off the Goto Islands," though I gave no indication of the source of this record. Among the localities I also gave Futschau (Fuchow). The specimens on which this was based were 2 in the Hamburg Museum which really represent *C. grandicalyx*.

In 1913 in a paper on the unstalked crinoids of eastern Asia I gave as a locality for this species "Eastern Asia (probably Korean Straits)." No indication for the basis of this record was given, but the specimen bearing this locality is one in the Copenhagen Museum collected by Captain Suensson.

In 1922 Dr. Torsten Gislén recorded this species (as *Comantheria grandicalyx* and as *C. grandicalyx* var. *flagellipinna*) from 3 of Dr. Sixten Bock's stations in the Bonin Islands.

COMANTHERIA DELICATA (A. H. Clark)

Plate 62, Figures 174, 175

Phanogenia delicata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 393 (description; *Albatross* station 5153).

Comaster delicata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 171 (nearly related to *C. taviana*); Crinoids of the Indian Ocean, 1912, p. 87 (synonymy; locality); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 37 (in key; range); p. 42 (references; station 282); p. 275 (listed); pl. 14, fig. 18.—GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 36 (compared with *C. d.* var. *grandis*).

Comaster delicata var. *grandis* GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 32 (Bock's stations 45, 51, 59, 60; descriptions and comparisons); figs. 26–29, p. 44; pl. 1, fig. 4.

Comaster delicata grandis GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 41 (details of arms); p. 44 (reversion); p. 77 (syzygies); figs. 139, 140, p. 95 (pinnule articulations).

Diagnostic features.—The centrodorsal is large and discoidal and bears a moderate number of fairly stout cirri which are about one-third as long as the arms, from 20 to 25 mm. in length, and are composed of 24–25 segments. The opposing spine, as in *imbricata*, is transverely elongated. The longest cirrus segments are from one-third to one-half again as long as broad, while in *imbricata* they are about as long as broad or very slightly longer than broad. The arms are 30–47 in number. The elements of the division series have everted and prominent finely spinous distal ends and the brachials have strongly produced and overlapping finely spinous distal edges. Combs occur at intervals to about the thirtieth pinnule. The color is commonly (though not always) white with purple, yellow, or brown markings. The cirri are always conspicuously marked with narrow bands of a darker color, such crossbands occurring occasionally also in *imbricata*.

Description.—The centrodorsal is large, discoidal, with a broad flat polar area 5 mm. in diameter. The cirrus sockets are arranged in a single slightly irregular marginal row.

The cirri are XIII–XIX, 24–25, moderately stout, from 20 to 25 mm. long. The first segment is about twice as broad as long, and those following gradually increase in length to the fourth or fifth, which is as long as broad, and the 3 or 4 succeeding, which are from one-third to one-half again as long as broad. The following segments decrease in length, the terminal 14 or 15 being about twice as broad as long. The second and following segments have the distal dorsal edge slightly prominent. After the seventh or eighth, which is a well-marked transition segment, the distal dorsal edge becomes strongly produced and finely serrate, this production very gradually narrowing distally and at the same time gradually becoming crescentic and gaining in height. The antepenultimate segment bears a subterminal transverse ridge which bends distally on either side as it decreases in height. The opposing spine is small, median, erect, transversely elongate, not reaching one-fourth the lateral width of the penultimate segment in height. The terminal claw is longer than the penultimate segment, moderately stout, evenly tapering, and moderately and evenly curved.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx bridging over the narrow clefts between the centrodorsal and the radials.

The radials are only very slightly visible in the interradial angles over the ends of the basal rays. The IBr_1 are almost entirely, or quite, concealed, very short, and almost entirely united laterally. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long, with the anterior angle rather produced and the lateral edges free. The IIBr series are 4 (3+4), well separated laterally; the $IIBr_1$ are united in their proximal two-thirds, but separated by a broad U-shaped gap distally. The IIBr series are 2, very rarely 4 (3+4).

Arms 30–31, slender, from 70 to 80 mm. long. The first 2 brachials are approximately equal, slightly wedge-shaped, about twice as broad as the median length; the first are almost entirely united interiorly. The first syzygial pair (composed of brachials 3+4) is from half again to twice as broad as long, oblong in shape. The next 3 brachials are oblong, about twice as broad as long, and those following become wedge-shaped, almost triangular, half again as broad as long, after the proximal third of the arm becoming gradually less obliquely wedge-shaped, though remaining of about the same relative length, and in the terminal portion of the arm becoming wedge-shaped and as long as or longer than broad. The elements of the division series have everted and prominent finely spinous distal ends, and the brachials have strongly produced and overlapping finely spinous distal ends.

Syzygies occur between brachials 3+4, 11+12, or 12+13, and distally at intervals of 4 muscular articulations.

The disk is 13 mm. in diameter. The mouth is marginal and radial. There are a few scattered calcareous granules about the central anal tube.

P_D is 15 mm. long, slender, and composed of 40 segments, all of which are approximately as long as broad. The terminal comb arises suddenly and is made up of 7 teeth which are triangular, longer than broad, rather longer than the width of the segments which bear them, rather strongly incurved, and basally in apposition. P_1 is similar, slightly less stout basally, equal in length or slightly longer. P_2 is small and weak, 6 mm. long. P_3 is similar, composed of 20 segments and 5 mm. long. P_4 is 6 or 7 mm. long, considerably stouter than the 2 preceding pinnules, with the distal ends of the segments strongly produced and bearing a gonad. The following pinnules are slightly stouter, with larger gonads, and slowly increase in length. The distal pinnules are very slender, about 9 mm. long, and are composed of about 20 segments, of which the first 2 are short and the following increase in length to about twice as long as broad, then decrease again in the terminal portion.

The color in alcohol is white, the arms beyond the basal portion with broad broken lateral lines and dorsal bands of violet; the cirri are white with occasional bands of light violet.

Notes.—The specimen from *Siboga* station 282 has 20 arms 65 mm. long, and the cirri XIII, 14, 8 mm. long. In the cirri the fifth or sixth, usually the former, is a transition segment.

In 1 of the 3 specimens from Bock's station 45 as described by Gislén the dorsal pole of the centrodorsal is 4 mm. in diameter. The cirri are arranged in 2 rows.

The cirri are XXVII, 23–27, from 25 to 30 mm. in length. The longer ventral cirri have 25–27 segments, and the shorter dorsal have 23–25 segments.

The radials are visible in the angles of the calyx. The IBr_1 are four times as broad as long, and are in contact in the proximal half but free in the distal half. The IBr_2 (axillaries) are low pentagonal, half again as broad as long. The 2 elements of the IBr series are united by synarthry. The IIBr series (9 present) are 4 (3+4). The IIIBr series (13 present) are 2. The IVBr series (3 present) are 4(?). The $IIBr_1$ are almost wholly united interiorly. There is a synarthrial tubercle on the IIBr series and another on the IIIBr series.

The arms are 35+ (probably originally 39) in number, 125 mm. long. The width of the arm proximally is 2.2 mm. and in the middle 1.7 mm. The arm bases in this and the following specimen are smoother than in the specimen from station 51.

P_D is 16 mm. long with about 40 segments, of which the terminal 7 bear teeth. The pinnule on the IVBr series is 15 mm. long with about 38 segments, of which the last 7 bear teeth. P_1 is 5 mm. long with about 25 segments, of which the last 6 bear teeth. P_2 is 3 mm. long with 18 segments. The pinnules following become longer. The distal pinnules are 7 mm. long with 18 segments. Combs occur at intervals to at least the twenty-fifth pinnule.

The disk is 18 mm. in diameter. The anal interradius is large and swollen and bears calcareous papillae. The color as preserved is grayish yellow.

In another specimen from Bock's station 45 the cirri are XX, 19–27, from 12 to 25 mm. long. The long ventral cirri have 26–27 segments, and the short dorsal have 19–20 segments. The IIBr series are 4 (3+4) (9 present). The IIIBr and IVBr series are 2, and there is present also a single VBr 2 series. The 47 arms are 105 mm. long. P_D is from 11 to 13 mm. long with 24–37 segments, of which the terminal 6 or 7 bear teeth. P_1 is from 5 to 9 mm. long with 20–35 segments. P_2 and P_3 are very short, from 4 to 6 mm. long. The distal pinnules are 6 mm. long with 16–18 segments. Combs occur at intervals to the twenty-fifth or thirtieth pinnule. The disk is 14 mm. in diameter. The anal interradius bears coarse and large calcareous plates.

In this specimen the division series beyond the IIIBr series are developed externally in reference to the IIBr series, the inner face of the axillaries bearing an undivided arm. The arm branching, therefore, resembles superficially that of *Comatella* and not that of the species of *Comaster*, in which division series and undivided arms alternate in relative position on successive axillaries.

In the third specimen from Bock's station 45 the centrodorsal is finely pitted; it is 2.5 mm. in diameter, with the free dorsal pole 1.5 mm. in diameter. The cirri are XVII, 15–20, from 10 to 19 mm. long. The sixth-eighth cirrus segments are the longest, half again as long as broad. The ninth is a transition segment. The opposing spine reaches from one-fourth to one-third the width of the penultimate segment in height.

The IBr_1 are four times as broad as long and are laterally free. There is a weak synarthrial tubercle on the articulation between the elements of the IBr series. The IIBr series are 4 (3+4).

The 13 arms are 65 mm. in length. The distal intersyzygial interval is 3 or 4 muscular articulations.

P_1 has 25 segments, of which the last 6 or 7 bear teeth. P_2 is from 5.5 to 9 mm. long and bears a comb with 5 teeth. P_3 and P_4 are 4.5 mm. long and bear a comb with 4 teeth. The first 5 pinnules have small spiny dorsal processes on the second-fifth segments. Combs occur at intervals as far as the fifteenth pinnule.

The disk is 9 mm. in diameter. The anal interradius has large calcareous papillae. The mouth is marginal. The color in alcohol is white.

In the specimen from Bock's station 51 the centrodorsal is thick discoidal, 10 mm. in diameter; the free dorsal pole is flat with somewhat raised margins, 5 mm. in diameter. The cirrus sockets are arranged in from 2 to 3 rows.

The cirri are XLII, 27–32, from 35 to 40 mm. in length. The shorter dorsal cirri have 27–28 segments and the longer ventral 30–32. The first 2 segments are broader than long, the third and fourth are about as long as broad, and the fifth-ninth are from somewhat longer than broad to half again as long as broad. The eleventh segment is again about as long as broad, and from about the fifteenth segment onward the segments are about twice as broad as long. Dorsal spines, which are very small, in height equaling only about one-sixth the width of the segments, are developed from the eleventh segment onward. The opposing spine is very small, about as long as the preceding dorsal spines. The terminal claw is one-quarter again as long as the preceding segment.

The IBr_1 are almost completely hidden by the centrodorsal. The IBr_2 are pentagonal, twice as broad as long, with the distal borders weakly concave. The IIBr series are 4 (3+4). The IIIBr series are 2 in 8 cases out of 13. The IVBr series are 4 in all 13 cases. The dorsal perisome is visible in the narrow interspaces between the IIBr series and the IBr axillary. There is a distinct synarthrial tubercle on the articulation between the first 2 elements of the IIBr series. The $IIBr_1$ are completely united interiorly. From the $IIBr_2$ onward the distal edges of the ossicles are everted and provided with small spines.

The 46 arms are 130 mm. long. At the base the arms are from 3 to 3.5 mm. in width, and in the middle 2 mm. The first 7 brachials are oblong, those following having oblique ends and being from two to three times as broad as long. There are 13 or 14 brachials for each 10 mm., or 11 if the syzygial pairs are counted as units.

Syzygies occur between brachials 3+4, 12+13, and 17+18, and distally at intervals of 4 or 5 muscular articulations.

P_D is from 14 to 17 mm. in length with about 40 segments, of which 6–8 bear teeth. The pinnule on the IVBr series is 10 mm. long with 32 segments, of which 5–6 bear teeth. P_1 and P_2 are of decreasing size. P_3 is 5 mm. long with about 20 segments, its comb consisting of 5 teeth. The small size of P_3 is not always so pronounced, but P_2 or P_3 are most often the shortest. Combs occur, most often on alternate pinnules, to the twentieth or twenty-fifth pinnule, and occasionally even to the thirtieth pinnule. The basal segments of the pinnules are distally somewhat everted and bordered with spines. The genital pinnules are 7 mm. long. The distal pinnules are 9 mm. long, with 20–25 segments; there are dorsal hooks on the last 9–12 segments. In the posterior arms the pinnules beyond that on the IVBr series are swollen with genital products.

The disk is 25 mm. in diameter, smooth, without calcareous granules or papillae. The anal funnel is central, short, and verruciform, 4 mm. high.

The color in alcohol is yellow brown, the cirri whitish with brown transverse bands.

In the specimen from Bock's station 59 the cirri are XXIV, 11–15, the longest 10 mm. in length. The third segment is half again as long as broad. The fourth and fifth segments are twice as long as broad. The sixth or seventh is a transition segment. The dorsal spines are very indistinct. The opposing spine is one-quarter the width of the segment which bears it.

The radials are almost entirely concealed by the centrodorsal. The IBr_1 are three times as broad as long, almost wholly free laterally. The IBr_2 (axillaries) are twice as broad as long, their lateral edges making an obtuse angle with those of the IBr_1. The IIBr series are 4 (3+4), the $IIBr_1$ being united interiorly. The single internal IIIBr series is 4.

The 21 arms are 55 mm. long. The distal brachials are half again as long as broad, narrow, almost smooth, though overlapping distally.

The arrangement of the syzygies is as in the succeeding specimen.

P_D has about 30 segments, of which the terminal 7–8 bear teeth. P_1 is 7 mm. or less in length with about 30 segments, of which the last 7 bear teeth. P_2 is 4 mm. long with 21 segments, of which the last 7 bear teeth. P_3 is 3.7 mm. long with 18 segments and a comb of 5 teeth. P_6 is 4.5 mm. long with 21 segments and a comb of 6 teeth. There are spiny processes on the proximal pinnule segments. Combs with 5–6 teeth occur at intervals at least to the thirteenth pinnule. The distal pinnules are 5.5 mm. long with 16–17 segments, of which the last 2 bear dorsal hooks.

The disk is 7.5 mm. in diameter and papillose. The mouth is marginal and the anus central.

In the specimen from Bock's station 60 the centrodorsal is 4 mm. in diameter, with the free dorsal pole 1.5 mm. in diameter.

The cirri are XXII, 20–30, from 13 to 26 mm. in length, arranged in 2 rows on the centrodorsal. The shorter dorsal cirri have 20–21 segments, and the longer ventral 26–30. The fourth segment is a little longer than broad, the fifth-seventh or -eighth are half again as long as broad, and those succeeding become shorter again. From the seventh or eighth onward the segments have a polished surface and dorsally transverse crests with small spines. The opposing spine reaches in height one-quarter the width of the segment that bears it.

The radials are visible in the interradial angles. The IBr_1 are three times as broad as long and are laterally free. The IBr_2 (axillaries) are pentagonal, twice as broad as long; their lateral margins form an obtuse angle with those of the IBr_1. The IIBr series are 4 (3+4). The IIIBr series, present in 4 cases, are 2. The distal borders of the IBr axillary bear small spines, as does the following ossicle, but for the rest the arm bases are rather smooth.

The 20 arms are 90 mm. long, the brachials being 1.2 mm. broad. There are 14 brachials for each 10 mm., or 11 if the syzygial pairs are counted as units.

The arrangement of the syzygies is as in the specimen from Bock's station 51.

P_D is 10 mm. long with 35 segments, of which the terminal 8 bear teeth. P_1 is 9.5 mm. long with 31 segments, of which the terminal 6 bear teeth. P_2, P_3, and P_4 are of decreasing length, from 4 to 3.5 mm. long, composed of 15–20 segments, of which the last 5 bear teeth. Short combs occur at intervals to the twenty-fifth pinnules, these intervals becoming very large after the fifteenth pinnule. The distal pinnules are 6.5 mm. long with 17 segments.

The disk is 11 mm. in diameter and is finely papillose. The anal tube is central.

The color is yellowish red.

Gislén has given the distribution of the combs on the pinnules on selected arms in his specimens in detail. On an arm arising from a IIIBr axillary in the specimen from Bock's station 51 combs occur on the following pinnules: First to sixth, eighth, tenth, eleventh, fifteenth, seventeenth (the eighteenth and nineteenth pinnules are lacking), twenty-first, twenty-third, twenty-fifth, and twenty-seventh. On the inner side of the same arm they are found on the following pinnules: First to sixth, eighth, tenth, twelfth, fourteenth, sixteenth, seventeenth, nineteenth, and thence usually at longer intervals.

On an arm arising from a IIIBr axillary on the first specimen from Bock's station 45 combs occur on the following pinnules: First to fifth, seventh, ninth, eleventh, thirteenth, fifteenth, seventeenth, eighteenth, twentieth, twenty-second, and twenty-fourth.

On an arm arising from a IIIBr axillary in the second specimen from Bock's station 45 combs are found on the following pinnules: First to fourth, sixth (the eighth pinnule is broken), tenth, twelfth, thirteenth, nineteenth, twenty-first (the twentieth to the thirtieth pinnules are broken), and thirty-first.

On an arm arising from a IIBr axillary in the specimen from Bock's station 60 combs occur on the following pinnules: First to fifth, seventh, ninth, fourteenth, and twentieth.

On an arm arising from a IIBr axillary in the specimen from Bock's station 59 combs are found on the following pinnules: First; the second and third are usually very small and sometimes without a comb; fourth, sixth (the seventh to eleventh pinnules are broken), fourteenth. On other arms in this specimen not more than from 6 to 8 pinnules on each side of the arm bear combs.

Localities.—*Siboga* station 282; anchorage between Nusa Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.). Pl. 62, fig. 175.

Albatross station 5153; Tawi Tawi group, Jolo (Sulu) Archipelago; Tocanhi Point bearing S. 27° E., 2.1 miles distant (lat. 5° 18′ 10″ N., long. 120° 02′ 55″ E.); 89 meters; coral sand and shells; February 19, 1908 [A. H. Clark, 1909, 1912, 1918] (2, U.S.N.M., 25463, 34975). Pl. 62, fig. 174.

Dr. Sixten Bock's expedition to Japan station 45; Bonin Islands, east of Chichijima; 164 meters; July 31, 1914 [Gislén, 1922] (1, U.S.N.M., E. 1117).

Dr. Sixten Bock's expedition to Japan station 51; Bonin Islands, in the channel; 73 meters; August 3, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 59; Bonin Islands, eastnortheast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 60; Bonin Islands, eastsoutheast of the channel; 152 meters; August 16, 1914 [Gislén, 1922].

Geographical range.—The Lesser Sunda, Phillipine and Bonin Islands.

Bathymetrical range.—From 54 (?27) to 89 meters. It probably extends into deeper water. The depths given for Bock's stations represent not the actual depth, but the amount of line out.

Parasite.—Gislén found in the pinnules and arms of specimens from the Bonin Islands a new entoparasitic myzostomid which he compared to *Protomyzostomum*.

History.—This species was originally described in 1909 from 2 specimens collected by the *Albatross* in the Philippines. In 1918 another specimen was recorded which had been collected by the *Siboga* at Timor.

In 1922 Dr. Torsten Gislén recorded 6 specimens which had been collected by Dr. Sixten Bock in the Bonin Islands in 1914. Gislén suggested the varietal name *grandis* for the specimens from the Bonin Islands, as they are larger than the type with more numerous cirri and cirrus segments and an abundance of IVBr series. It is doubtful whether such a difference between individuals from the Bonin Islands and the Philippines actually exists, for it is among the Philippines and adjacent islands that the comasterids locally reach their largest size and greatest development, and it is scarcely to be supposed that this species would furnish an exception.

Genus COMANTHUS A. H. Clark

Comatula (part) Lamarck, Hist. nat. des animaux sans vertèbres, vol. 2, 1816, p. 533.

Comaster (part) L. Agassiz, Mém. soc. de sci. nat. Neuchâtel, vol. 1, 1835, 1836, p. 193 (genotype *Comatula multiradiata* Lamarck which includes a specimen of *Comanthus bennetti;* by subsequent authors largely used with the genotype *Comatula multiradiata* Goldfuss, 1832 = *Comanthus bennetti;* used by A. H. Clark, 1908, with the genotype *Asterias multiradiata* Linné 1758, but this corrected in 1909).

Alecto (part) J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 187.

Comatula (*Actinometra*) (part) J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 256.

Comatula (*Alecto*) (part) J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 261.

Actinometra (part) Dujardin and Hupé, Hist nat. des zoophytes, Echinodèrmes, 1862, p. 210, and following authors.

Actinometra (*Comatula*) (part) P. H. Carpenter Journ. Anat. and Physiol., vol 10, 1876, pp. 574, 582.

Actinometra P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 204.

Antedon (part) Bell, Proc. Zool. Soc. London, 1882, p. 533; Ann. and Mag. Nat. Hist., ser. 5, vol. 10, 1882, p. 225; Marine Invest. in South Africa, vol. 4, part 4, 1905, p. 139.

Goldfussia Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, No. 40, April, 1891, p. 387 (genotype *Comatula multiradiata* Goldfuss).—Bather, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 464 (preoccupied).—Norman, Ann. and Mag. Nat. Hist., ser. 6, vol. 8, No. 44, August, 1891, p. 180.—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 89 (history).

Actrinometra (part) Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 97.

Phanogenia (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 124.

Comanthus A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 220 (used as a generic name for 2 new species, *C. intricata* and *C. decameros*); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203 (diagnosis; genotype *Alecto parvicirra* J. Müller, 1841); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 363 (tropical genus occurring in southwestern Australia); Proc. U. S. Nat.

Mus., vol. 36, 1909, p. 506 (synonymy; genotype; distribution); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 175 (referred to the Comasterinae); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 141 (revised and divided into 3 subgenera, *Comantheria*, *Comanthina*, and *Comanthus*); p. 142 (genotype *Comanthus intricata* A. H. Clark = *Actinometra valida* P. H. Carpenter); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 652 (no infrabasals in the young); Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 129 (characteristic of the Japanese fauna; significance); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 730 (in key); p. 732 (in key); p. 733 (key to the subgenera; key to the species in the subgenus *Comanthus*); p. 747 (equivalent in Carpenter's classification); pp. 751, 754 (original reference); Zool. Anzeiger, vol. 39, No. 11–12, 1912, p. 421 (habit compared with that of *Neometra sibogae*); Crinoids of the Indian Ocean, 1912, p. 11 (western limit of the large highly multibrachiate species is Ceylon); p. 17 (significance of the conditions in this genus in southern Japan); pp. 55, 56 (in keys); p. 89 (synonymy; genotype); Die Crinoiden der Antarktis, 1915, p. 163 (geographical range); American Naturalist, vol. 49, 1915, p. 525 (bathymetrical range); p. 539 (asymmetrical disk); p. 540 (1 or more rays dwarfed); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 34 (in key; range); p. 48 (key to the included subgenera and species).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 16 (rejection of the included subgenera); p. 16, footnote 1 (discussion of gender).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 53 (pinnule combs); Zool. Bidrag från Uppsala, vol. 9, 1924, p. 35 (brachial homologies); p. 51 (obliquity of brachials); p. 117 (relation to fossils).

Comanthus (*Comanthus*) A. H. Clark, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 29.

Diagnosis.—A genus of Comasterinae in which the elements of the IBr series and the first 2 ossicles following each axillary are united by synarthry; most of the axillaries bear either 2 division series or 2 undivided arms; the IIBr, IIIBr, and subsequent division series (if present) are either all 4 (3+4), or 4 (3+4) and 2 in varying proportions, with no regularity whatever in the occurrence of division series of 2 elements.

Geographical range.—From Hong Kong, Amoy, southern Japan, the Philippine, Bonin, Pelew, Caroline, Gilbert, and Samoan Islands, Tonga, Fiji, New Caledonia, New Zealand, Australia, and Tasmania, westward to Baluchistan, the Seychelles, Madagascar, and southern Africa as far as the vicinity of Cape Town.

Bathymetrical range.—From the shore line down to 256 (?548) meters. Of the 12 included species, 10 are found between the shore line and 50 meters; 6 occur between 50 and 100 meters; 5 are found between 100 and 150 meters; 4 live between 150 and 200 meters; 2 are found between 200 and 300 meters; and 1 extends deeper than 300 meters.

Remarks.—Of the 12 species included in the genus *Comanthus*, 2 are extraordinarily variable in all their characters. The cirri may be well developed, poorly developed, deficient, or wholly absent. The division series are very rarely all 4 (3+4), but are almost invariably 4 (3+4) and 2 in varying proportions in different individuals; there is no regularity whatever in the replacement of division series of 4 (3+4) by division series of 2. The arms are exceedingly variable in stoutness and especially in length, and may be very greatly elongated and attenuated. The different arms may vary very greatly in the same individual. The terminal combs may be confined to the proximal pinnules, or they may occur at intervals far out on the arm, and even on the distal pinnules; furthermore, they may be of different types.

These two species (*timorensis* and *parvicirra*), which are very much alike and possibly only forms of the same species, are herein regarded as constituting a special subgenus, *Comanthus* in the strict sense. Both are very wide ranging, and usually abundant wherever they occur.

The other 10 species, included in the subgenus *Cenolia*, are far less variable in their characters, and in them the range of individual variation is relatively slight. All of them are rather local and several are very local. The only one which occurs in the Malayan Archipelago, where the species of the other group are especially abundant, is decidedly rare.

The largest species (*bennetti*) of the subgenus *Cenolia* is rather sharply differentiated from the others. It is remarkable for its great size. There may be as many as 120 arms which are up to 205 mm. in length. The cirri are large and stout and are peculiar in being composed of up to 35 subequal segments which lack dorsal processes. P_1 is very long, sometimes reaching nearly 60 mm. The very strongly convex division series of this species, which are also all 4 (3+4) and therefore uniformly long, give it a characteristic appearance, whereby it is easily distinguished from the equally large species in other genera.

A second species (*plectrophorum*) is to a certain extent intermediate between the preceding and the group of species following, but is unique in having the segments of the proximal and middle pinnules very strongly crested as in *Comanthina belli*.

A curious group of 3 large species (*pinguis*, *japonica*, and *solaster*), all closely related and possibly to be regarded as forms of the same species, is found from southern Japan to Hong Kong. Two of these (*pinguis* and *solaster*) show a curious correspondence to two species of *Comantheria* (*imbricata* and *intermedia*) inhabiting the same region, although the last two seem not to be very closely related to each other.

On the coasts of southern Australia, Tasmania, and New Zealand there is found a group of 4 species (*trichoptera*, *tasmaniae*, *benhami*, and *novaezealandiae*) which are all very closely related to each other. Each of these inhabits a special region where none of the others is found. This contrasts with the conditions occurring in the preceding group, all 3 species of which live together. With this group the small South African species (*wahlbergii*) shows the closest affinity.

The last species (*samoana*) is a rather variable form, which tends to approach the species of the subgenus *Comanthus*, and indeed is not always easily distinguished from certain forms of *C.* (*C.*) *parvicirra*.

KEY TO THE SUBGENERA OF THE GENUS COMANTHUS

*a*¹. Cirri always present, numerous and evenly distributed about the periphery of the centrodorsal, always well developed and usually stout, with the distal segments markedly shorter than the proximal and laterally compressed, composed of numerous (except in 2 species more than 20) segments; IIBr, IIIBr, and following division series almost invariably 4 (3+4); anterior arms never excessively elongate and attenuated (South Africa from Simons Bay to the Tugela River mouth; Ceylon to Tasmania and New Zealand, New Caledonia, Fiji, Tonga, Samoa, the Gilbert, Caroline, and Pelew Islands, southern Japan, and Hong Kong; 0–256 [?548] meters) Cenolia, p. 530.

*a*². Cirri few, small and weak, with the distal segments only slightly shorter than the proximal and only slightly, if at all, compressed laterally, irregularly distributed about the periphery of the centrodorsal and often confined to the interradial angles, sometimes altogether absent; IIBr and IIIBr series usually 4 (3+4) and 2 in varying proportions, very rarely all 4 (3+4); anterior arms often excessively elongated and attenuated (Madagascar, Mauritius, the Seychelles, and Baluchistan to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, and Amoy, China; 0–110 meters)---- Comanthus, p. 603.

Subgenus Cenolia A. H. Clark

Bennettia A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (type *Alecto bennetti* J. Müller, 1841; diagnosis); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 13 (common to South Africa and Ceylon, but not found in the Arabian Sea); Mem. Australian Mus., vol. 4, 1911, p. 754 (original reference; characters; range); Crinoids of the Indian Ocean, 1912, p. 10 (greatly developed in Japan); p. 11 (occurs both east and west of Ceylon); p. 12 (represented in the southeast African region); p. 93 (synonymy; = *Goldfussia* Norman, preoccupied; type).

Cenolia A. H. Clark, Proc. Biol. Soc. Washington, vol. 29, 1916, p. 48 (subgenus; no diagnosis; used in the combination *Comanthus* [*Cenolia*] *trichoptera*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 34 (in key; range); p. 48 (subgenus of *Comanthus*; in key).

Diagnosis.—A subgenus of *Comanthus* including those species in which the IIBr series are almost invariably 4 (3+4), and the cirri are always present and numerous, usually stout, laterally compressed distally, and evenly distributed about the periphery of the centrodorsal.

Geographical range.—From southern Japan, Oceania, and Australia to Ceylon and southern Africa. This subgenus alone is represented in New Zealand, Tasmania, southern Australia, and southern Africa, and is the characteristic comasterid type in southern Japan.

Bathymetrical range.—From the shore line down to 256 meters. This subgenus occurs for a considerable depth beyond the lowest limit of the other subgenus, *Comanthus*.

KEY TO THE SPECIES IN THE SUBGENUS CENOLIA

- a^1. More than 60 (usually more than 70) arms; cirri with the distal segments only slightly shorter than the proximal, dorsally more or less swollen, but entirely without dorsal processes; centrodorsal very large, hemispherical, with a deeply concave dorsal pole; cirri large, stout, well developed, and numerous, with 20–35 (usually 25–30) segments; size large, the arms 130–205 mm. long (Andaman Islands to northern Australia, the Loyalty, Pelew, and Marshall Islands, the Philippines, and Macclesfield Bank; 0–50 [?64] meters) ------- **bennetti, p. 531.**
- a^2. Less than 60 arms; cirri with the distal segments much shorter than the proximal and always with a more or less developed dorsal process in the form of a keel, tubercle, or carinate spine, or sometimes a distal serrate transverse ridge.
  - b^1. Cirri very long, stout, and numerous, the longest composed of more than 32 segments; centrodorsal large, more or less hemispherical, with a relatively small concave dorsal pole; usually about 40 arms; size large, the arms 100–200 (commonly 150–200) mm. in length.
    - c^1. Proximal and middle pinnules with the segments in the basal portion produced dorsally into conspicuous dorsal processes which on the lower segments may be as high as the width of the segments themselves (southeastern Australia and Bass Strait; 183–548 meters) -- **plectrophorum, p. 550.**
    - c^2. No conspicuous dorsal processes on the basal segments of the proximal and middle pinnules.
      - d^1. Division series very broad, so that only narrow strips of perisome, or none at all, are visible between them, and much flattened dorsally; axillaries with the anterior angle acute (southern Japan to Hong Kong; 25–188 [?288] meters) --------- **pinguis, p. 553.**
      - d^2. Division series narrow and strongly convex dorsally, so that large areas of perisome are visible between them; axillaries with the anterior angle acute (southern Japan; 0–256 meters) --- **japonica, p. 564.**
  - b^2. Cirri shorter and more slender, with fewer than 30 (usually fewer than 25) segments; centrodorsal discoidal with a broad flat dorsal pole; seldom more than 35 arms; size smaller.
    - c^1. Cirri mostly more or less undeveloped and very variable in size, composed of a very variable number of segments, though always with fewer than 30 and usually with fewer than 25; division series very broad and flattened dorsally and in close lateral contact, so that no perisome is visible between them (southern Japan and southward to Formosa [Taiwan]; 0–197 meters) --- **solaster, p. 576.**

- e^2. Cirri all, or nearly all, mature, the majority of approximately the same size; number of cirrus segments variable within relatively narrow limits; division series broad and more or less flattened dorsally, but always with more or less perisome visible between them.
  - d^1. Axillaries with the anterior angle acute and somewhat produced; cirri slender, numerous, and but little recurved distally.
    - e^1. Cirri longer and stouter, with 24–27 (usually 26–27) segments (west coast of South Island, New Zealand; 4.6–6 meters) ---------------------------- **benhami**, p. 587.
    - e^2. Cirri shorter and more slender, with less than 24 segments.
      - f^1. Cirri with about 20 segments; 20–35 arms (southern Australia, from Cape Hawke, New South Wales, to Bunbury, Western Australia; 0–73 meters). **trichoptera**, p. 579.
      - f^2. Cirri with 14–17 segments.
        - g^1. Longest proximal cirrus segments about two and one-half times as long as broad; earlier cirrus segments with unmodified distal ends; 37 arms (Tasmania). **tasmaniae**, p. 586.
        - g^2. Longest proximal cirrus segments about twice as long as broad; earlier cirrus segments with swollen distal ends; 20 arms (Three Kings Island, New Zealand; 119 meters) ------------------------------------ **novaezealandiae**, p. 588
  - d^2. Axillaries with the anterior angle obtuse and not produced; cirri less slender, less numerous, and more strongly recurved distally.
    - e^1. Stout and robust, with usually 16–20 short, stout, and rapidly tapering arms which are usually about 60 mm. long; cirri less strongly recurved and laterally compressed distally (South Africa from the Tugela River mouth to Simons Bay; 0–46 meters). **wahlbergii**, p. 588.
    - e^2. More slender , with usually about 20 slender and slowly tapering arms which are usually 50–70 mm. long; cirri more strongly recurved and laterally compressed distally (Ceylon to tropical Australia, the Solomon Islands, New Caledonia, Fiji, Tonga, Samoa, the Gilbert, Caroline, and Pelew Islands, and the Philippines; 0–40 meters). **samoana**, p. 593.

COMANTHUS BENNETTI (J. Müller)

Plate 66, Figures 186, 187; Plate 67, Figure 188; Plate 68, Figure 189; Plate 82, Figure 225

[See also vol. 1, pt. 1, figs. 173, 174 (centrodorsal), p. 231; pt. 2, figs. 171, 172 (analysis of arm structure), p. 86; figs. 426, 427 (pinnule tip), p. 257]

?*Caput-Medusae brunnum* Linck, De Stellis marinis, 1733, pl. 22, fig. 34.—Brugière, Encyclopédie méthodique, 1792, pl. 125, fig. 3 (copy of Linck's figure).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, pt. 1, Dec. 1879, p. 2 (history; an *Actinometra*).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 279.

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Lamarck's and Goldfuss' use of the name).—ALLMAN, Trans. Roy. Soc. Edinburgh, 1863, p. 246 (from Goldfuss).—QUENSTEDT, Petrefactenkunde Deutschlands, vol. 4, Asteriden u. Encriniden, 1876, p. 165, pl. 96, fig. 19 (from Goldfuss).—P. H. CARPENTER, Nature, vol. 15, Jan. 4, 1877, p. 198 (of Goldfuss is a *Comaster;* of Lamarck is an *Actinometra*); Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 455 (discussion of Goldfuss); Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 5 (of Lamarck; mouth excentric or even marginal; = *Caput-Medusae brunnum* Linck); p. 9 (renamed, on the basis of an examination of Lamarck's specimen by Troschel, *multifida* by Müller); p. 16 (name *multifida* adopted by Dujardin for this type); Journ. Linn. Soc. (Zool.), vol. 15, 1880, p. 188 (of Lamarck, made the type of *Comaster* by Agassiz; basals of Goldfuss' specimen); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 323 (discussion of the name).—NORMAN, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 386 (type of *Comaster*).—BATHER, Ann. and Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 464 (of Goldfuss; type of *Goldfussia* Norman; of Lamarck; type of *Comaster* Agassiz; of doubtful identity).—NORMAN, Ann. and Mag. Nat. Hist., ser. 6, vol 8, No. 44, Aug. 1891, p. 181.—A. H. CLARK, Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (of Lamarck is *Capillaster sentosa* + *Comaster multifida* + *Comanthus bennetti*); p. 247 (history of the name as applied by Linné, Lamarck, and Goldfuss); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 711 (history of the name as applied by Lamarck and Goldfuss); Crinoids of the Indian Ocean, 1912, p. 2 (identity of Goldfuss' specimen).

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Comanthus (*Cenolia*) *bennetti* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 50 (synonymy; notes; stations 133, 240, 299).

Diagnostic features.—The centrodorsal is large, flattened hemispherical, with the dorsal pole concave. The cirri are numerous, large and stout, with 23–35 (most commonly 25–30) segments, of which the distal are only slightly shorter than the earlier and, though swollen dorsally, are without dorsal processes or a dorsal carination. The arms are 48–120, usually 80 or more, in number, and are up to 205 mm. in length.

The general appearance of this species, with its long and strongly convex division series, large centrodorsal, and numerous stout cirri lacking dorsal processes, is very characteristic and unlike that of any other comatulid.

Description.—The centrodorsal is large, flattened hemispherical, 12 mm. in diameter, with the concave dorsal pole 6 or 7 mm. across. The cirrus sockets are large and very closely crowded, arranged in usually 4 alternating rows.

The cirri are XL–LX (rarely as few as XX or XXV), 23–35 (most commonly 25–30), large and stout, from 30 to 40 mm. in length. The first segment is very short and the following gradually increase in length to the sixth, which, with the remainder, is slightly broader than long, the distal segments being only very slightly shorter than those nearer the base. The cirrus segments are all perfectly smooth and rounded dorsally, with no trace of spines or carination. The dorsal profile of the segments in the distal half is more convex than of those in the proximal half. The opposing spine is represented by a minute blunt median tubercle which arises in an obtuse angle from the entire dorsal surface of the penultimate segment. The terminal claw is usually half again as long as the penultimate segment and is stout basally, becoming slender in the distal half, and moderately curved.

The ends of the basal rays are visible in the interradial angles of the calyx; in cross section or in end view they are more or less like a trefoil in outline.

The radials are concealed by the centrodorsal in the median line, but their anterolateral angles rise abruptly in the interradial angles, forming over the ends of the basal rays an equilateral triangle with convex sides and the apex reaching almost or quite to the IBr axillary. The IBr_1 are short and very broad with the lateral borders concave, corresponding to the convex sides of the interradial triangles formed by the anterolateral angles of the radials, over the apices of which they meet in more or less blunted points. The IBr_2 (axillaries) are almost or quite triangular, from three to three and one-half times as broad as long, and are almost or quite in lateral contact. The IIBr series are 4 (3+4), strongly rounded dorsally, and separated interiorly by the very stout basal portion of the P_D, which are just in contact. The IIIBr series, IVBr series, and VBr series are all 4 (3+4), the last usually present in about half of the full number, the others all present. The division series are all strongly rounded dorsally and are separated by the broad basal portions of the pinnules which they bear, these being always just in contact, so that no perisome is visible in a dorsal view.

The arms are 48–120 in number, usually about 80, and are from 140 to 205 mm. in length. They are rather strongly compressed laterally and rather strongly rounded dorsally. The first brachials are wedge-shaped, about twice as broad as the interior (lesser) length, and almost entirely or quite united interiorly. The second brachials are oblong, about twice as broad as long. The first syzygial pair (composed of brachials 3+4) is about as long as broad. The following 5 brachials are oblong, about twice as broad as long, and those succeeding become wedge-shaped and after the thirteenth almost or quite triangular, about twice as broad as long, and after the ends of the proximal third of the arm gradually shorter, the ends at the same time becoming less and less oblique, so that the brachials in the outer half of the arm are almost or quite oblong and four times as broad as long, or even rather broader. The dorsal and lateral surfaces of the elements of the division series are slightly concave, causing the ends of the ossicles to appear rather prominent, and the brachials after the eighth or tenth develop strongly produced and overlapping distal ends which are armed with fine spines.

Syzygies occur between brachials 3+4, again from between brachials 10+11 to between brachials 38+39 (usually with a variation of from 4 to 6 brachials in any one individual), and distally at intervals of from 3 to 10 (usually 4) muscular articulations. In the specimen from the Pelew Islands the second syzygy varies from between brachials 26+27 to 30+31, and the distal intersyzygial interval is almost invariably 4 muscular articulations.

The disk is from 30 to 45 mm. in diameter. The mouth is radial or interradial, usually intermediate between these two positions, marginal or submarginal. The anal tube is subcentral. The disk is naked, or bears a few scattered calcareous granules, most commonly in the anal area.

P_D is very long, from 30 to nearly 60 mm. in length, according to the size of the specimen, very stout basally, 2 mm. broad at the base in a large example, but evenly tapering and becoming comparatively slender after the middle. It is composed of 70–75 segments all of which are about half again as broad as long except those in the terminal portion, which are about as long as broad. The terminal comb consists of 17 teeth which are low, roughly transversely oval, becoming more nearly circular distally, with a strongly constricted pedicel, and not so high as the width of the segments that bear them. The pinnules on the succeeding division series are similar, but decrease rapidly in length and stoutness. P_1 is 20 mm. long (15 mm. in a small specimen), moderately stout basally but rapidly tapering and very slender for most of its length, with about 45 segments. P_2 is 10 mm. long, slender basally, much more like P_3 than like P_1. P_3 is only 7 mm. long, small and weak, with about 25 segments and bearing a comb distally. P_4 resembles P_3 and, like it, bears a usually more or less defective terminal comb. The following pinnules are composed of about 20 segments; they are very slightly stouter, and very slowly increase in length; their component segments are at first short, but become longer than broad distally, and have more or less prominent distal ends, so that the pinnule as a whole has a serrate dorsal profile. The last 3 or 4 segments are armed dorsally with 3 or 4 long recurved spines. The distal pinnules are slender, about 13 mm. long, with the first 2 segments short and those following slowly increasing in length and becoming about twice as long as broad distally. All of the segments have produced and overlapping distal ends.

The color in alcohol varies from light to very dark brown, with the centrodorsal and the cirri lighter; some specimens are reddish brown or olive green.

Notes.—Of the 3 specimens from Table Island, 1 has 78 arms 160 mm. long, and the cirri XX, 32–35, from 40 to 50 mm. long. The centrodorsal is large and hemispherical, 11 mm. in diameter, the bare dorsal pole being 5 mm. in diameter and strongly concave. The disk is 40 mm. in diameter and bears calcareous nodules about the anal tube. The anal area is very large, and the anal tube is central. The mouth is marginal and radial.

Another specimen has 76 arms 140 mm. long, and the cirri XXX, 29–31, 40 mm. long. The disk is 30 mm. in diameter. The anal tube is covered with calcareous concretions. The mouth is interradial.

The third specimen has 78 arms 120 mm. long, and the cirri XXVII, 27–33, from 33 to 40 mm. in length. It is similar to the 2 preceding.

In all 3 specimens all of the division series are 4 (3+4).

In the specimen from Singapore in the Hamburg Museum, according to Carpenter, the centrodorsal reaches 12 mm. in diameter. The cirri are much longer and stouter than in Müller's type. Some of them reach 35 mm. in length and are composed of 35 segments. The basal segments are very broad, and there are few if any segments that are at all longer than broad.

The calyx and division series are of the same nature as in the type. All of the division series are 4 (3+4). The surface of the brachials is smooth and even. The fourth and following brachials are almost devoid of the articular tubercles which are visible in the corresponding brachials of the type specimen, though in some arms they are slightly developed. The remaining brachials are essentially similar to those of the type, except that they are somewhat wider in proportion to their length, while the second syzygy is rather farther from the base, though Carpenter did not find it as far out as the thirty-eighth brachial, as in the case of the specimen from the Loyalty Islands described by Bölsche.

This specimen is remarkable for the great length of the lower pinnules, which may reach 40 mm., although they are relatively slender, none of the segments except the broad basal ones being especially stout. These lower pinnules, and in fact the arms as a whole, are much more clothed with perisome than are those of the type specimen at Leyden.

The mouth is interradial.

I found this specimen to be a magnificent example of the species, resembling the one from the Pelew Islands in the Copenhagen Museum.

The specimen from *Siboga* station 299 is a beautiful and typical example, with about 120 arms which are 180 mm. long. The cirri are about XL, 26–28, from 35 to 40 mm. in length, and are typically stout and smooth. All of the arms are grooved.

Goldfuss's figure of a specimen from the Indian Ocean (probably the Dutch East Indies) shows only a single IIBr series with all the succeeding division series. As this bears 8 arms, the total number of arms must have been about 80. The ends of the basal rays are visible as small tubercles, with above them a gablelike structure formed of the everted and thickened adjacent lateral borders of the radials. All of the division series are 4 (3+4). A single fully developed cirrus is shown which has 25 subequal segments, the distal without dorsal processes.

The specimen from *Siboga* station 240 is similar to that from *Siboga* station 299. It has about 80 arms which are about 180 mm. long. The cirri are XXI, 27–32, from 35 to 45 mm. in length. One of the IIIBr series is 1 and two are 2. All of the other division series are 4 (3+4).

One of the specimens collected at Banda by the Danish expedition to the Kei Islands has 74 arms 150 mm. long. All the division series are 4 (3+4). The centrodorsal is 8 mm. in diameter and has the dorsal pole strongly concave. The cirri are XXVII, 26–28, up to 40 mm. in length. The other specimen has 72 arms 140 mm. long. All the division series are 4 (3+4). The cirri are XXVI, 26–29, up to 35 mm. in length.

Hartlaub said that one of the 4 specimens collected by Brock at Amboina showed the characters of *peroni*. The cirri, which are arranged in 2 rows on the centrodorsal, are XXV, 28. The second syzygy on some arms is between brachials 14+15 or 15+16 and on others between brachials 19+20 or 20+21. The diameter of the disk is 21 mm. This specimen is smaller than the others and of more slender build.

The 3 other specimens agree in their characters. The cirri are XXX–XL, 27–30, the longest about 40 mm. in length. Some of the cirri are slender and compressed and others are stout. In respect to their cirri these specimens are intermediate between *peroni* and *bennetti*.

As described by Professor Koehler, the specimen collected by Bedot and Pictet at the Bay of Amboina lacks a part of the disk as well as the arms on an entire side of the body. The other arms are broken toward the tip, so that it is impossible to estimate their length.

The dorsal pole of the centrodorsal is strongly concave. The cirri are arranged in 3 rows.

The cirri are XXXVIII, 26–28, and are composed of segments which are as long as broad and are without dorsal processes.

The radials are scarcely visible. The rays divide four times. The IIBr, IIIBr, IVBr, and VBr series are all 4 (3+4). The first ossicles following an axillary are interiorly united.

The pinnules of the division series are more than 40 mm. long and are as large at the base as, and broader than, the cirri. Most of the pinnules have the tips broken off, but some are entire, and these have about 60 segments. The terminal comb is feebly developed. Koehler said that the pinnules showed the characters indicated by Carpenter; that is, that the ventral edges of the segments are produced so as to stand up as plates sloping slightly inward toward the ambulacral groove.

The disk is 40 mm. in diameter. The mouth is interradial.

The color as preserved is greenish olive.

One of the specimens collected by the Danish expedition to the Kei Islands at Amboina has 78 arms 170 mm. long; the cirri have 24–27 segments. The other specimen is small, with 60 arms 150 mm. long; the longest cirri have 21–27 segments.

The specimen from the south coast of Ceram was described by Carpenter as a distinct species under the name of *Actinometra peronii.*

The centrodorsal, according to Carpenter, is a convex disk somewhat hollowed in the center. The cirri are arranged in 2 rows.

The cirri are XXV–XXX, about 30, stout and long, sometimes reaching 40 mm. in length. The segments are tolerably equal in legnth. They increase in length up to about the sixth and then slowly diminish. The later segments are somewhat compressed laterally and the penultimate bears a faint opposing spine.

The radials are only visible in the interradial angles, where the small tubercles representing the ends of the basal rays are visible. The IBr_1 are planoconvex, barely meeting laterally. The IBr_2 (axillaries) are widely pentagonal, with rather sharp distal angles. The rays divide three, or occasionally four, times. All of the division series are 4 (3+4). The $IIBr_1$ are very slightly united interiorly, the first ossicles after the other axillaries being rather more closely united. The rays are well separated, the perisome between them and that between their first divisions being covered with minute plates.

The 66 arms are about 125 mm. long. They are composed of 150–200 brachials. The first 2 brachials are somewhat variable in shape, the first being rather the longer. The first syzygial pair (composed of brachials 3+4) is oblong or nearly square. The next 5 or 6 brachials are nearly oblong, those following gradually becoming short and sharply wedge-shaped, with slightly raised distal edges. Toward the middle of the arms the brachials are shorter and blunter, with finely denticulate edges, and the terminal ones are oblong or nearly square. The distal margins of most of the brachials have pointed anterior projections which occur alternately on opposite sides. The anterior arms are slightly longer than the posterior.

Syzygies occur between brachials 3+4, and again from between brachials 20+21 to between brachials 26+27, and distally at intervals of from 4 to 10, usually 4 or 5, muscular articulations.

The second elements of all the division series bear long pinnules. The first 2 are tolerably equal, 30 mm. long, with large basal segments. The size decreases rapidly to about the eighth brachial, after which the pinnules are uniform in length for a few brachials, but gradually become stouter. Those following slowly increase in length to near the end of the arm, but they are always much shorter than the lowest pinnules.

The earlier pinnules bear a well-marked terminal comb which disappears after about the tenth brachial.

The disk is 35 mm. in diameter. The mouth has no very definite position. Between it and the anal tube there are a few calcareous granules.

The color in alcohol is light brown.

Carpenter believed this fine specimen to be specifically identical with one in the Bonn Museum and another in the Paris Museum. The former, without locality, was mentioned by Müller in 1849, and the latter was one of the three referred to by Lamarck under the name of *Comatula multiradiata*. He said that this type is very similar to *bennetti*, but differs in having fewer cirri, and in the segments composing them being tolerably uniform in size. The brachials are relatively shorter, while both the first and the subsequent intersyzygial intervals are longer than in *bennetti*. The pinnules, which have stouter and shorter segments, are more clothed with perisome.

The specimen from the Moluccas collected by Péron and Lesueur in 1803 is of medium size. It has 56 arms, and the cirri are composed of 26–29 segments.

The specimen from the Danish expedition to the Kei Islands station 20 has 80 arms about 160 mm. long. All of the division series are 4 (3+4). The cirri are XXVII, 30–32, up to 40 mm. in length.

The specimen from *Siboga* station 133 I at first considered as representing a new species which I described under the name of *Comanthus crassicirra*. It is evidently very immature, for the irregularity in the numbers of the arms on the different rays indicates that it is undergoing adolescent autotomy.

The centrodorsal is flattened hemispherical, small, with a flat dorsal pole 2 mm. in diameter. The cirrus sockets are arranged in one and a partial second irregular marginal rows.

The cirri are XVII, 17–24, from 15 to 24 mm. long, and are large and stout. The first segment is short, and those following increase in length to the fourth, which is nearly or quite as long as broad, and still further increase to the fifth and sixth or sixth and seventh, which are the longest, nearly or quite half again as long as broad. The succeeding segments gradually decrease in length so that the last 8 or 10 are slightly broader than long. On the fully developed cirri, which are evidently not of the type which the animal will possess when adult, the twelfth or thirteenth and following segments have small subterminal dorsal tubercles. The shorter distal segments are slightly compressed laterally and have a polished surface, though this begins gradually without a transition segment. The opposing spine is small, low, and broad, median or subterminal. The earlier cirri have slight dorsal processes, and this led me to consider this specimen as representing a species near *C. japonica*. But the latter cirri appear to be quite without them. In very young *C. japonica* the young cirri possess very strong dorsal processes.

Deep but very narrow subradial clefts are present.

The mouth is interradial and submarginal. The anal tube is central.

The radials are just visible beyond the edge of the centrodorsal, extending well up in the angles of the calyx. They are slightly separated distally, so that the bases of the IBr_1 are rather widely separated. The IBr_1 are short, with a convex proximal border and slightly converging sides. They are about three times as broad as the median length. The IBr_2 (axillaries) are broadly pentagonal, twice as broad as long. The anterior angle is sharp, the anterior sides are concave, and the lateral edges are about as long as those of the IBr_1, with which they make an obtuse angle.

The 17 arms are 120 mm. long. There are 3 IIBr and 4 IIIBr series present, all of which are 4 (3+4). Of the IIIBr series, 3 are internal and the fourth is external at the side of one of the preceding. The division series are narrow, so that a large amount of perisome is visible in dorsal view. This is protected by numerous irregular calcareous plates.

P_1 is 20 mm. long, stout basally, and tapering rapidly in the proximal third, but more gradually from that point onward. It is composed of 38 segments. The terminal comb is borne on the last 14 segments and is composed of low rounded teeth which become obsolete on the 3 terminal segments. P_2 is much shorter than P_1 and proportionately less stout, though similar. It possesses 28 segments and is 10 mm. long. The comb consists of 9 teeth, of which the first 3 are small. There are no teeth on the 3 or 4 terminal segments. P_3 is small and slender, 7 mm. long, with 23 segments. P_4 is slightly smaller and more slender than P_3, 6 mm. long, with only a rudimentary comb. P_5 is 5.5 mm. long and is composed of 17 segments; it does not bear a comb. It is very slightly stouter than the 2 preceding pinnules and tapers more evenly to the very delicate tip. The following pinnules are similar. The distal pinnules are very slender, 8 mm. long, with 17 segments.

The color is grayish brown, the cirri yellowish.

Of the specimens from Port Galera, Mindoro, one has about 120 arms which are about 170 mm. long. Another has about 100 arms, and the cirri composed of 27–29 segments and from 40 to 45 mm. in length. A third has about 85 arms 205 mm. long. A fourth has about 85 arms 160 mm. long. Another has 80 arms about 185 mm. long; a single cirrus with 31 segments remains.

The specimen from the Pelew Islands has about 120 arms which are 150 mm. in length. The cirri are XXXV, 30, 40 mm. long, large and robust, and are placed on a large convex centrodorsal with a deeply concave dorsal pole.

Of the 2 specimens from Ekalin, St. Matthias Island, one is medium sized, with about 70 arms. The dorsal surface of the division series and arms is finely granular and very rough. The disk is 35 mm. in diameter. The other is smaller, with 48 arms about 115 mm. long. One of the IIBr series is 2 and bears externally a single IIIBr 2 series.

Herr Schöde's specimens from St. Matthias Island are all rather small, with about 60 arms. In one of them several of the division series are 2 instead of the usual 4 (3+4). The distal cirrus segments are laterally flattened and are about twice as broad as long. They are perfectly smooth dorsally.

In the specimen from Uvea, as described by Bölsche, the diameter of the centrodorsal reaches 12 mm. The dorsal pole is concave and has a diameter of 6 mm.

The cirri are about L, 30. At the base the cirri are circular in cross section, but toward the end the cross section becomes elliptical. In the middle of the fully developed cirri the segments are not longer than broad. There is a small blunt opposing spine.

Hartlaub described the cirri in this specimen as XL, 30, long and stout, arranged in 3 rows on the centrodorsal.

The radials are concealed. All of the division series beyond the IBr series are 4 (3+4).

The 79 arms are 140 mm. long. The 5 rays bear 16, 15, 18, 15, and 15 arms. The brachials are short. Under a glass it is seen that their surface is bedecked with small longitudinal ribs which run to the distal edge and here end in overlapping spinelets.

The first brachial syzygy occurs between brachials 3+4 and the next after 18–32 muscular articulations. From this point onward the intersyzygial interval is 4–8 muscular articulations.

Pinnules occur on the second ossicle following each axillary. The end segments of the first 5–7 pinnules possess on their inner side moderately high overlapping fine longitudinally grooved teeth, and those of most of the other pinnules 2 or more rows of small recurved spinelets.

The disk is 28 mm. in diameter. It bears a few scattered short blunt concretions. The middle of the disk carries the long anal tube. The mouth lies near the margin. From it grooves run unsymmetrically to the arms. The division series as far as the second or third are united by perisome.

The color in alcohol is brown.

Doctor Willey's specimen from the Loyalty Islands is large. The cirri are XXIV, 21–22, smooth, stout, and well developed, arranged in 2 rows on the centrodorsal. The outer IIIBr series are 2, all the other division series being 4 (3+4); VBr series are present.

The specimen from the South Seas has about 70 arms which are about 160 mm. long.

In the specimen from Jaluit the centrodorsal is large, hemispherical, 6 mm. in diameter at the base.

The cirri are XX, 17–20, 20 mm. long, and stout. The proximal segments are about as long as broad, the distal from one-third to one-half again as broad as long, and perfectly smooth dorsally.

There are about 60 arms which are about 130 mm. long. All the division series are 4 (3+4). The division series are strongly rounded dorsally and well separated.

This appears to be a dwarf specimen of this species.

Carpenter thus redescribed the 2 specimens at Leyden which served as the basis for Müller's original description of *Alecto bennetti*.

The centrodorsal is large, convex, and hollowed in the center, with 2 or 3 irregular rows of cirrus sockets on its sides and its angles produced into short processes, above which the ends of the basal rays are sometimes visible.

The cirri are XL–L, about 25, the segments rather stout. The fifth or sixth segment is slightly longer than broad, the next 3 or 4 are slightly the longest, and those following decrease very gradually in length, nearly all of them being longer than broad. The terminal segments are slightly compressed laterally, and the penultimate has a very faint opposing spine.

Portions of the radials are just visible in the interradial angles of the calyx. The IBr_1, which are partially concealed by the large centrodorsal, have curved proximal borders and are more or less united laterally. The IBr_2 (axillaries) are broadly pentagonal, with concave distal borders. The succeeding division series are all 4 (3+4). The rays divide four, or sometimes five, times.

The 70–80 arms are about 140 mm. in length. The first brachials are large, partly united with their fellows, and not quite oblong, their outer sides being slightly longer than the inner. The second brachials are somewhat shorter and more nearly oblong. The first syzygial pair (composed of brachials 3+4) is square, or just longer than broad. The next 4 or 5 brachials are transversely oblong, their proximal edges having slight basal projections alternately on opposite sides. The following brachials are longer, rather sharply wedge-shaped, with spiny overlapping distal edges. After the fortieth brachial they become shorter, blunter, and more oblong and overlap less distinctly.

Syzygies occur between brachials 3+4, again from between brachials 16+17 to between brachials 19+20, and distally at intervals of 3–6 (usually 4 or 5) muscular articulations.

The second ossicles after each axillary bear long pinnules. The first 2 are nearly equal, nearly 30 mm. in length and composed of 70 segments. The size decreases to P_1, which is not quite half as long as P_D. The next 5 or 6 decrease rather more rapidly, and those following increase again. The pinnules as far as the third or fourth brachial have very strong blunt processes on their last 12 or 15 segments. On the next 6 or 8 brachials the terminal comb becomes less and less prominent, and finally disappears altogether.

The disk is from 30 to 35 mm. in diameter. It bears a few calcareous granules, especially about the anal tube. The mouth is radial, or nearly so. All the arms are grooved. The dorsal perisome uniting the rays and their divisions is more or less plated as far as the IIIBr axillaries.

The color in alcohol is brown or reddish brown.

Carpenter noted that the 2 specimens differ slightly in the number of cirri and in the extent of the bare dorsal pole of the centrodorsal. They also differ in the development of spines upon the brachials and in the extent to which the perisome is plated between the division series.

A specimen without locality in the Hamburg Museum Carpenter said differs in points of detail from the type at Leyden. It is considerably mutilated, nothing remaining but the calyx, arm bases, and disk. The mouth, as in the type, is nearly radial, though not absolutely so. The centrodorsal reaches 12 mm. in diameter, and the cirri are much longer and stouter than in the type. Some of them reach 35 mm. in length and are composed of 35 segments. The basal segments are very broad, and there are few, if any, that are at all longer than broad. All of the division series are 4 (3+4). The brachials have the distal edges slightly raised and somewhat spiny. There are no articular tubercles. The specimen is remarkable for the great length of the lowest pinnules, which may reach 40 mm., but are relatively slender, none of the component segments except the broad basal ones being especially stout.

Abnormal specimens.—In view of the constancy of the division series in this species, it seems advisable to call attention to the few deviations which have been recorded.

In the *Siboga* specimen from Banda one of the IIIBr series is 1, and two are 2.

In Duncker's specimen from Ekalin, St. Matthias Island, one of the IIBr series is 2 and bears externally a single IIIBr 2 series.

In one of Schöde's examples from St. Matthias Island several of the division series are 2.

In Willey's specimen from the Loyalty Islands the outer IIIBr series are 2, all the other division series being 4 (3+4).

Localities.—*Investigator;* Table Island, Coco group, north of the Andamans; 27–64 meters [A. H. Clark, 1911 (as Bay of Bengal), 1912] (3, I. M.). Pl. 67, fig. 188; pl. 68, fig. 189.

Singapore [P. H. Carpenter, 1882, 1888; A. H. Clark, 1909, 1912] (1, H. M.).

Siboga station 299; Boeka or Cyrus Bay, south coast of Rotti Island, southwest of Timor (lat. 10° 52′ 24″ S., long. 123° 01′ 06″ E.); 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Indian Ocean [Goldfuss, 1832; J. Müller, 1849; Quenstedt, 1852, 1876; Bronn, 1860; Dujardin and Hupé, 1862; Allman, 1863; P. H. Carpenter, 1877, 1879, 1880, 1881, 1888; Norman, 1891; Bather, 1891; A. H. Clark, 1912].

Siboga station 240; anchorage at Banda; 9–45 meters; black sand and coral; lithothamnion bank; November 22–December 1, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 467).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Banda; June 14, 1922 (2).

Amboina; Dr. J. Brock, 1884–85 [Hartlaub, 1891; A. H. Clark, 1912]. Same, Professor Strubell, 1890 [Reichensperger, 1912].

Bay of Amboina; MM. Bedot and Pictet [Koehler, 1895].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; breakwater; about 1 meter; February 28, 1922 (2).

South coast of Ceram; Hoedt [P. H. Carpenter, 1881, 1888; Hartlaub, 1891; A. H. Clark, 1911, 1912] (1, L. M.).

Moluccas; Péron and Lesueur, 1803 [Lamarck, 1816; J. Müller, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1881, 1888; A. H. Clark, 1911, 1912] (1, P. M.). Same [von Graff, 1887; A. H. Clark, 1912].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 20; 50 meters; sand and shells; April 14, 1922 (1).

Siboga station 133; anchorage off Lirung, Salibabu Island, Talaoer group, southeast of Mindanao; down to 36 meters; mud and hard sand; July 25–27, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.). Pl. 82, fig. 223.

Jolo (Sulu) Sea [P. H. Carpenter, 1888; A. H. Clark, 1912] (fragments, M. C. Z).

Port Galera, Mindoro; Dr. Laurence E. Griffin (7, M. C. Z., 621, 669, 670).

Philippine Islands [A. H. Clark, 1912].

Macclesfield Bank; 24 meters [Bell, 1894; A. H. Clark, 1912, 1913] (1, B. M.).

Pelew Islands [Lütken, 1877; P. H. Carpenter, 1888; A. H. Clark, 1909, 1911, 1912] (1, C. M.) Pl. 66, figs. 186, 187.

Ekalin, St. Matthias Island, Bismarck Archipelago; reef; Dr. G. Duncker [A. H. Clark, 1912] (2, H. M.).

St. Matthias Island; H. Schöde [A. H. Clark, 1912, 1913; Hartmeyer, 1916] (5, Berl. M., 5939).

New Britain; Prof. Arthur Willey [Bell, 1899; A. H. Clark, 1912, 1913] (1, B. M.).

Port Denison, Queensland [Lütken, 1877; Hartlaub, 1891; A. H. Clark, 1911, 1912] (1, H. M.).

Uea (Uvea or Halgan), Loyalty Islands, east of New Caledonia; Doctor Gräffe [Bölsche, 1866; Ludwig, 1877, 1879; P. H. Carpenter, 1879, 1881, 1888; Hartlaub, 1891 (as Uca); A. H. Clark, 1912 (as Uca, Solomon Islands)]. Same [P. H. Carpenter, 1881].

Loyalty Islands; Prof. Arthur Willey [Bell, 1899; A. H. Clark, 1912, 1913] (2, B. M.).

Lelti Island [A. H. Clark, 1912, 1913] (1, B. M.).

Jaluit, Marshall Islands; Hernsheim, September 5, 1888 [A. H. Clark, 1912] (1, H. M.).

South Seas; Dr. Otto Finch [A. H. Clark, 1912] (1, Berl. M., 5350).

No locality; George Bennett [J. Müller, 1841, 1843; Dujardin and Hupé, 1862; P. H. Carpenter, 1879, 1881, 1882; Bell, 1882; A. H. Clark, 1911] (2, L. M.). Same [J. Müller, 1849; P. H. Carpenter, 1881]. Same [A. H. Clark, 1912] (1, H. M.).

Geographical range.—From the Andaman Islands to northern Australia, the Loyalty, Pelew, and Marshall Islands, the Philippines, and Macclesfield Bank.

Bathymetrical range.—Chiefly littoral; from the shore line down to 50 (?64) meters.

History.—Dr. P. H. Carpenter suggested that the figure of Linck's *Caput-Medusae brunnum* represents a species of Comasteridae, and this conclusion is undoubtedly justified. Indeed, one may go a step further and say that *Comanthus bennetti* is with little doubt the species depicted.

Lamarck's *Comatula multiradiata*, which was described in 1816, was based upon 3 specimens which had been collected in the Moluccas by Péron and Lesueur in 1803. Each of these 3 specimens represented a different species. One was an example of *Capillaster sentosa*, another an example of *Comanthus bennetti*, and the third was described by Johannes Müller, as a reidentification of *Comatula multiradiata*, under the name of *Alecto multifida*.

In 1832 Georg August Goldfuss described and figured in detail under the name of *Comatula multiradiata* a specimen from the Indian Ocean—probably the Dutch East Indies. There can be no doubt that his figure represents an example of *bennetti*.

Much confusion has arisen in regard to this specimen for the reason that Goldfuss described it as having conspicuous basals, plates which do not occur externally in any of the recent comasterids. An examination of his figure shows, however, that the supposed basals are in reality the small ends of the basal rays plus a gablelike structure above them formed from the everted and thickened adjacent lateral borders of the radials. Such a condition is not infrequent in the large comasterids. Carpenter described the same thing in his original diagnosis of *Comanthina schlegelii*, though he failed to detect the correspondence between the interradial structure in this specimen and in the one figured by Goldfuss.

In 1839 Goldfuss referred his *Comatula multiradiata* to the genus *Comaster*, which had been erected by Louis Agassiz in 1836.

In 1841 Müller described under the name of *Alecto bennetti* 2 specimens in the Leyden Museum which had been collected by Mr. George Bennett, but which had no definite locality label. Müller had not himself seen the specimens, his description being based upon notes furnished him by Troschel.

Speaking of Goldfuss' specimen, Müller said that the Indian *Comatula multiradiata* of Goldfuss differs from the ordinary comatulids through the possession of basals, and added that Mr. Agassiz had correctly erected a special genus, *Comaster*, for its reception. But Agassiz' genus *Comaster* was based upon the *Comatula multiradiata* of Lamarck, and not upon the *Comatula multiradiata* of Goldfuss. The *Comatula multiradiata* of Lamarck, which is not the same as the *Asterias multiradiata* of Linné, 1758, was reidentified by Müller and redescribed as *Alecto multifida*. The type of *Comaster*, therefore, is *Comatula multiradiata* Lamarck, 1816 (not *Asterias multiradiata* Linné, 1758) = *Alecto multifida* J. Müller, 1841.

Müller added that he regarded Agassiz' genus *Comaster* (with the assumed type *Comatula multiradiata* Goldfuss) as not different from the fossil genus *Solanocrinus*.

Müller believed that since *Comatula multiradiata* Lamarck, 1816, and *Comatula multiradiata* Goldfuss, 1832, are different species, and since Lamarck's species is quite unrecognizable from his description, the name *multiradiata* must hold for Goldfuss' type, which was adequately described and figured.

In 1849 Müller repeated without change his original description of *bennetti*, referring it to the genus *Comatula*.

He said that he was unable to determine with certainty the specimen figured by Goldfuss; but if the drawing of the ossicles of the division series is correct and syzygies were not overlooked, the species would be *Comatula bennetti*, as it agrees with that form in the large number of arms, in the form and number of the ossicles in the division series, and also in the number of the cirrus segments.

He remarked that Goldfuss's dissected specimen is no longer to be found in the collection at Bonn. But he found there another complete specimen in alcohol labeled *Comatula multiradiata*. In this the cirri have up to 23 segments. All of the axillaries are syzygial pairs, and on the arms there are about 6 muscular articulations between successive syzygies. He noted that this had not so many arms as the one figured by Goldfuss, and in this feature, as well as in the occurrence of syzygies in the axillaries, it agrees with the *multiradiatus* of Retzius (*Capillaster multiradiata*).

Dujardin and Hupé in 1862 under the name of *Comatula bennetti*, published a translation of Müller's original description of this species. In their description of *Comatula multifida* they said that the number of arms may rise as high as 50. This number I believe to have been taken from the specimen of *bennetti*, with 56 arms, which was collected by Péron and Lesueur in 1803 and included by Lamarck in his *Comatula multiradiata*. They accepted *Comaster* as a genus distinct from *Comatula*. In it they included only a single species, *Comaster multiradiatus* Goldfuss, under which they erroneously included as a synonym *Comaster multiradiatus* Agassiz, which is the *Alecto multifida* of Müller, 1841.

In 1866 Dr. Wilhelm Bölsche described in detail a specimen of *bennetti* in the Göttingen Museum which had been collected in the Loyalty Islands by Doctor Gräffe. He noted that Müller's original description was incomplete, and that, through Professor Keferstein, he had had Herr Herklots, the conservator of the Reichs-Museum in Leyden, make a comparison between his description and Müller's original specimens in order to confirm the identification.

It was this specimen which was studied by Prof. Hubert Ludwig, then at Göttingen, and which was mentioned by him in 1877 and 1879.

In 1877 Prof. Christian F. Lütken listed *Actinometra brachymera* from Port Denison and the Pelew Islands, but he gave no description of this new form.

Dr. P. H. Carpenter in 1877 discussed the genus *Comaster*, considered as including only *Comaster multiradiatus* Goldfuss, at great length. He said that the recent genus *Comaster*, or *Comatula multiradiata* of Goldfuss, from the Indian Ocean, has been considered by most authors generically identical with the fossil genus *Solanocrinus* on account of the appearance of the basals on the exterior of the calyx.

The condition of the central ends of the basals, however, and, in fact, of the whole calyx, is very remarkable and very unlike that presented by any other comatulid with which we are acquainted, while the differences between it and *Solanocrinus* are so very great that it is difficult to understand how they could ever have been regarded as belonging to one and the same genus.

He remarked that the centrodorsal of *Comaster* is hemispherical, but its margin is not infolded as a broad lip forming a wide superior ventral surface on which the radials rest. These last bear the axillaries directly, without the intervention of any IBr_1, which are always present in comatulids, and have very narrow inferior faces that simply rest upon the thick rim of the hemispherical centrodorsal basin. The inferolateral angles of every pair of contiguous radials are truncated, and the spaces left between them when they are in the natural condition of apposition by their lateral faces are occupied by the 5 triangular basals which rest on the rim of the centrodorsal basin, and are visible on the exterior of the calyx alternating with the radials, just like the peripheral ends of the basals of *Solanocrinus costatus*. In this species, however, the basals are longish rods of considerable relative width and are in contact by their central ends, while in *Comaster* they are small triangular pieces from the middle of the inner and lower edge of each of which there arises a toothlike process in the shape of a small cartilaginous rod extending to the center of the centrodorsal, which is grooved to receive it.

He noted that Goldfuss did not describe anything that could be regarded as a rosette in *Comaster*, and the small triangular basals would seem to be the ultimate condition of the embryonic basal plates, with which they exactly agree in their relative position. But the relations of their central processes are somewhat difficult to understand. They can hardly be regarded as comparable, except in their interradial position, to the rays of the basal star of the comasterids, for they lie in grooves on the floor of the cavity of the centrodorsal basin and are apparently independent of the radials, which have no extensive area of synostosis with the centrodorsal piece as in the comatulids—while from Goldfuss's account of them they do not seem to be calcified, but instead to be more of a cartilaginous nature.

Comaster, he continued, further differs from all the comatulids with which we are acquainted, and also from *Solanocrinus*, in the fact that the nervous cords are not lodged in canals which perforate the pieces of the calyx, but lie freely on the superior surface of the segments, the opposed terminal faces of which lie flatly against one another. The muscles and ligaments lie along their concave inner sides and cover in the freely exposed nerve cords. From the IIIBr axillaries onward, however, all the segments have articular surfaces of the usual character, and are perforated by central canals in which the nerve cords lie. This condition of the segments of the calyx of *Comaster* is of great interest, for, besides being the normal permanent condition in the tessellate crinoids, it is the embryonic condition, so far as the position of the nerve cords is concerned, in the comatulids.

Carpenter said that these facts will suffice to show the very great differences that exist in the skeleton alone between *Comaster* and the other comatulids, including *Solanocrinus*, with which genus it has been united on account of the appearance of the basals on the exterior of the calyx. In *Solanocrinus*, however, as in the other comatulids, the radials are perforated by central canals for the nerve cords, and the absence of this character in *Comaster* would alone justify our referring these 2 forms to separate genera, even if this were the only difference between them, which is by no means the case.

In 1879 Carpenter discussed *Comaster* at some length. He seems to have begun to suspect that there was something wrong with Goldfuss's description and figure of the calyx and associated structures, for he said that as *Comaster* has not been seen by any naturalist since the time of Goldfuss its position must still remain in doubt. He included *Actinometra bennetti* in the list of recent comatulids to be referred to the genus *Actinometra*.

In 1881 Carpenter redescribed the type specimens of *bennetti* at Leyden. He mentioned a specimen from Uea in the natural history museum at Stuttgart, and another from the Pelew Islands in the museum at Copenhagen. At the same time he described a new species, *Actinometra peronii*, based on a specimen collected by Hoedt on the south coast of Ceram. This he believed to be identical with one in the Bonn Museum which had been referred to by Müller in 1849, and another in the Paris Museum collected by Péron and Lesueur in 1803, both of which he had personally examined.

In 1882 Carpenter described 2 specimens in the Hamburg Museum, one from Singapore and the other without locality. In the same year Prof. F. Jeffrey Bell published specific formulas for both *bennetti* and *peronii*.

In the *Challenger* report on the stalked crinoids published in 1884 Carpenter said that he had been unable to find sacculi in *bennetti*. He divided the genus *Actinometra*, here used as including all the comasterids, into 8 groups (A–H) on the basis of the characters exhibited by the arm division. The last group, in which the IIIBr series are 4 (3+4), he called the group of *Actinometra bennetti*. He now had become more than ever uncertain about the actual existence of a form with the peculiarities described for *Comaster*, and he referred to it as "the doubtful *Comaster*."

In 1887 Prof. Ludwig von Graff described the myzostomes from a specimen from the Moluccas in the Amsterdam Museum.

In 1888 in the *Challenger* report on the comatulids Carpenter said that the leading character of *Comaster*, according to its proposer, depended upon the number of divisions in the arms, and was rightly disregarded by Goldfuss who thought more of the presence of basals on the exterior of the calyx as a generic distinction. He said that Müller adopted the genus in the sense in which it was understood by Goldfuss, but that he seems eventually to have abandoned it altogether. This will doubtless prove to be its ultimate fate, as it has not been seen by any naturalist since the time of Goldfuss, whose original specimen of it was dissected and has since disappeared. If his account of it is correct, *Comaster* must have been a very remarkable type differing in many respects from all other recent comatulids. But Carpenter was now inclined to believe that the apparent peculiarities are merely due to the want of knowledge respecting the internal structure of the calyx of comatulids which was prevalent at the time of Goldfuss, and that *Comaster* is in reality nothing but a large *Antedon* (in the broad sense in which the term was used by Carpenter) or *Actinometra* (comasterid). He placed *Comaster* of Agassiz, 1835 (really 1836), in the synonymy of *Actinometra*. *Comaster* as used by Dujardin and Hupé he placed under both *Antedon* and *Actinometra*, although the only included species mentioned by them was the *Comaster multiradiatus* of Goldfuss. *Comaster* as used by Lundgren, 1874, he placed in the synonymy of *Antedon*.

Carpenter did not discuss *bennetti* in detail, since it was not secured by the *Challenger*, but he gave its specific formula, several times mentioned the chief features of the arm division, and inserted it in the key to the species of the *Parvicirra* group of *Actinometra*. Here it fell in the section characterized by the presence of IIIBr 4 (3+4) series, and also IVBr 4 (3+4) series, and by having the cirri XL–L, 25. It was contrasted with *parvicirra*, *regalis*, *schlegeli* and *peroni*, in which the cirri were said to be X–XXX.

Among the localities for this species he included the Sooloo (Jolo) Sea, this record being based upon some arm fragments collected by the United States Exploring Expedition and now in the Museum of Comparative Zoölogy at Harvard University.

Of *peroni* he gave a specific formula, and mentioned the specimen which he had found among the 3 individuals included by Lamarck in his *Comatula multiradiata*. But the only locality he gave for this form was Ceram. He inserted it in the key to the species of the *Parvicirra* group, where it was distinguished by having 30 cirrus segments in contrast to *parvicirra*, *regalis*, and *schlegeli*, in which the cirrus segments number 10–20. He mentioned elsewhere that the cirri are very long.

Dr. Clemens Hartlaub in 1891 recorded and published notes upon 4 specimens which had been collected by Dr. J. Brock at Amboina. One of these had the characters described by Carpenter for *peroni*, and Hartlaub said that he believed the separation of these 2 supposed species could no longer be maintained.

He wrote to Carpenter expressing this opinion, and Carpenter replied that he agreed that the 2 forms are in reality identical.

Hartlaub reexamined the specimen at the Göttingen Museum from the Loyalty Islands which had been described by Bölsche in 1866, and in this he found additional evidence that *bennetti* and *peroni* are synonymous. The locality he gave us Uca, which is a slip for Uea.

In the Hamburg Museum he found a specimen from Port Denison bearing the manuscript name *Actinometra brachymera* of Lütken. This he determined as *bennetti.*

In April, 1891, the Rev. Canon Alfred Merle Norman pointed out that *Comatula multiradiata* Lamarck is the type of Agassiz's genus *Comaster,* and that this genus was erected to include forms allied to *Antedon* in which the arms are ramified instead of being simply bifurcated. He said that if there is such a form as that described by Goldfuss, which several authors have doubted, it will require the intervention of a new generic name, for which he suggested *Goldfussia.*

Dr. Francis Arthur Bather in May, 1891, indicated that *Goldfussia* is preoccupied.

Prof. F. Jeffrey Bell in 1894 recorded a specimen of this species from the Macclesfield Bank. In 1895 Prof. René Koehler recorded *Actinometra robustipinna* from the Bay of Amboina, which had been collected by MM. Maurice Bedot and P. Pictet. As the type specimen of Carpenter's *Actinometra robustipinna* is a species of *Himerometra,* Professor Koehler's record is undoubtedly based upon *bennetti,* which is the only comasterid that would fit Carpenter's description.

In 1899 Bell recorded (as *Actinometra grandicalyx*) a specimen from New Britain which had been collected by Prof. Arthur Willey.

In 1909 I recorded and gave notes upon a magnificent specimen from the Pelew Islands which, bearing the name *Actinometra brachymera* Lütken, is in the collection of the Copenhagen Museum. At the same time I remarked that Professor Koehler recorded a specimen of *Comanthus robustipinna* from Amboina, but that from his description it seems probable that the example really belongs to this species, which had previously been found at Amboina. I added that Carpenter's original description of *robustipinna* is perfectly applicable to certain specimens of *bennetti.*

In 1911 in a paper on the crinoids in the collection of the Leyden Museum I included in the synonymy of *Comanthus bennetti* the *Comatula multiradiata* of Goldfuss, 1832, the *Actinometra brachymera* (*nomen nudum*) of Lütken, 1877, and the *Actinometra peronii* of Carpenter, 1881. I also stated that the type specimen of *Actinometra robustipinna* had proved on examination to be a representative of a species of *Himerometra* and not an *Actinometra* at all. In another paper on the crinoids of the Paris Museum I gave notes upon the specimen of *bennetti* which had been collected in 1803 by Péron and Lesueur. In a memoir on the crinoids of Australia, also published in 1911, I repeated the synonymy given in the paper on the Leyden crinoids, and gave a summary of the knowledge of this species. The western extremity of the range was given as the Bay of Bengal. This referred to unrecorded specimens from the Coco Islands.

In 1912 in a paper on the crinoids of the Hamburg Museum I recorded and gave notes upon the 6 specimens in that institution. Three of these, one from Jaluit and 2 from St. Matthias Island, had not previously been recorded. In another paper on the crinoids of the Berlin Museum I listed and gave notes upon 6 specimens, 1 from the South Seas and 5 from St. Matthias Island. In my memoir on the crinoids of the Indian Ocean I gave a fairly detailed synonymy of this species, including references to the specimen included in Lamarck's *Comatula multiradiata* and that recorded by Bell under the name of *Actinometra grandicalyx.* Extended notes on 2 individuals from Table Island in the Coco group were given. I appended a complete list of localities. In this there appears "Uca, Solomon Islands," which is an error for Uea, Loyalty Islands, confused with Ughi in the Solomons. The last locality, Philippine Islands, refers to a preceding one, Sulu Sea. In a paper describing a number of new species contained in the *Siboga* collection which was published in 1912 there is included *Comanthus crassicirra*. This new form was said to be related to *Comanthus japonica*, and to be the first member of the small group to which *C. japonica* belongs to be brought to light south of Japan.

In 1912 Dr. August Reichensperger mentioned that the chambered organ of this species contains numerous spherules, which are found in all the chambers. He had 2 specimens of this form which came from among a number collected by Professor Strubell at Amboina in 1890 which were turned over to him by Prof. Hubert Ludwig.

In 1913 I published notes upon the 5 specimens in the British Museum. One of these, from Lelti Island, had not previously been recorded.

In 1918 I recorded 3 specimens from as many *Siboga* stations, and included the *Comanthus crassicirra* which I had described in 1912 in the synonymy of *bennetti*.

COMANTHUS PLECTROPHORUM H. L. Clark

Plate 23, Figure 62; Plate 69, Figures 190, 191

Comanthus plectrophorum H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, June 2, 1916, p. 15 (description; east of Flinders I., Bass Strait; 100–300 fathoms); pl. 4, fig. 1.

Diagnostic features.—The proximal and middle pinnules have the segments in their basal portion produced dorsally into conspicuous dorsal processes which on the lower segments may be as high as the width of the segments themselves. The centrodorsal is large and discoidal, 10 mm. in diameter. The cirri are very numerous, LV–LX, long, with 29–37 segments of which the distal are carinate with slightly produced distal edges.

Description.—The centrodorsal is about 10 mm. in diameter and more than 2 mm. high, with the bare dorsal pole very rough, slightly concave, and about 6 mm. across. The cirrus sockets are arranged in 3 crowded and irregular rows.

The cirri are LV–LX, 29–37, usually about 32. Some of the proximal segments, for instance the fourth-ninth, are longer than broad; the fifth is particularly long. Beyond the tenth (which from the figure appears to be a transition segment) the distal dorsal margin projects slightly, the segments become laterally compressed, and a marked dorsal keel is formed which is most fully developed on the 4 or 5 segments preceding the penultimate. When seen from the dorsal side this is more of a tubercle than a keel, but the lateral aspect is very keel-like.

The radials are entirely concealed. The IBr_1 are short and broad, in lateral contact for about three-fourths of their length. The IB_2 (axillaries) are very short and broad, at least three times as broad as long, and are not at all in contact with each other. Of the IIBr series 9 are 4 (3+4) and 1 is 2. Externally they are well separated from each other; internally the $IIBr_1$ are more or less in lateral contact. The IIIBr series are 4 (3+4), in 2 instances 2. The IVBr series, when present, are 4 (3+4). One of the 2 specimens has no IVBr series, but there are 4 in the other. In 1 specimen (that without IVBr series) the distal edges of the elements of the IIBr and IIIBr series are thickened and slightly flaring, and there is little indication of synarthrial tubercles; but in the other, while very slight synarthrial tubercles are indicated, the segments are all smooth and indistinct.

The arms are 40–44 in number, and are rather more than 100 mm. in length. The brachials soon become very markedly triangular with thickened, flaring, and roughened distal edges; but distally they again resume a quadrilateral form and the distal margins are not modified.

The first syzygy is between brachials 3+4, and the second from 8 to 16 brachials beyond. After the second syzygy there may be a second interval of from 8 to 10 brachials, but as a rule syzygies become frequent and very regularly spaced, in 1 specimen occurring at intervals of 4 and in the other of 5 muscular articulations.

The pinnules, especially the oral pinnules, are long and slender. P_D is more than 30 mm. in length and consists of more than 70 segments. The succeeding pinnules decrease in length to P_4, which is only about 15 mm. long and is composed of only 20–25 segments. The comb of the lowest pinnules consists of about 12–15 segments. The combs persist as far as P_4 on which the comb consists of 7 or 8 segments. The basal segments of all the pinnules except at the very tip of the arm are much broader than long. In the basal and middle portions of the arm from 3 to 12 of these broadened segments are conspicuous for their flaring spinulose margins which are prolonged on the aboral side into remarkable spinulose spurs. These spurs are largest and most fully formed on the basal segments, except the first 2, of the lowest pinnules. Passing distally along the arm as well as outward along each pinnule, these spurs become less and less evident and finally disappear.

The disk is about 30 mm. in diameter, and is quite fully plated, especially along the ambulacral grooves. The position of the mouth can not be determined.

The color in alcohol is light brown, the cirri being somewhat lighter than the arms. On drying the color becomes uniformly light fawn or very pale buff.

Notes.—A specimen from the Gippsland coast may be described as follows:

The centrodorsal is large, thick discoidal with beveled sides; the dorsal pole is 4 mm. in diameter with a pit 1.5 mm. in diameter in the center. The cirrus sockets are arranged in 3 and a partial fourth closely crowded and more or less irregular rows.

The cirri are very numerous, long and rather stout, XL, 29–30, from 35 to 40 mm. long. The first segment is very short, the second is longer, the third is about as long as, or somewhat longer than, broad, and the fifth-seventh or fifth-eighth are the longest, half again as long as broad. The segments following decrease in length so that the tenth or twelfth is about as long as broad and the distal segments are between half again and twice as broad as long. The seventh, eighth, or ninth may be a faintly marked transition segment, though on most cirri no definite transition segment is distinguishable. On the eighth or ninth segment the distal border dorsally is elevated and produced into a broad chisel-like edge. In the terminal portion of the cirri this narrows and the last 3 to 6 segments are very bluntly and roundedly carinate, in lateral view appearing to possess a high carinate dorsal process of which the crest is parallel to the axis of the segment. The opposing spine is low, conical, and much broader at the base than high. The terminal claw is slender, longer than the penultimate segment, strongly curved in the basal third but nearly straight in the distal two-thirds.

The ends of the basal rays are visible as small tubercle in the angles of the calyx just beneath the ends of the radials. Deep but very narrow subradial clefts are present.

The radials are visible only in the interradial angles where their anterolateral angles form a narrow and rather high triangle in the middle of the base of which is situated the end of the basal ray. The IBr_1 are extremely short and band-like, in the midradial line almost completely hidden by the centrodorsal. Their proximal lateral angles are just in contact above the triangle formed interradially by the anterolateral portion of the radials. From this point of contact the lateral sides, which are very short, diverge at a right angle. The IBr_2 (axillaries) are short, from somewhat more than twice to three times as broad as long, triangular, with the anterior sides moderately concave. The lateral angles project for some distance beyond the anterolateral angles of the IBr_1, and the proximal border of these lateral angles makes approximately a right angle with the lateral borders of the IBr_1. All 10 of the IIBr series are 4 (3+4). They are strongly and evenly rounded dorsally, inteiiorly quite and exteriorly almost in lateral contact, there being only a narrow strip of perisome visible beneath the bases of the adjacent P_D, which are in lateral contact. There are 19 IIIBr series, all of which are 4 (3+4). These resemble the IIBr series. The 2 arising from each IIBr series are in close contact interiorly. The 2 on either side of the miradial line are separated only by the bases of the P_D. Those on the outermost sides of the postradial series are separated from their neighbors by usually about half their width.

The 39 arms are 130 mm. long. The earlier brachials, beyond the proximal discoidal brachials, are triangular, about half again as broad as the longer side, after the proximal third of the arm becoming very obliquely wedge-shaped, and after the middle of the arm shorter, nearly twice as broad as the longer side, and distally longer again. The distal edges of the brachials are rather strongly produced and are armed with very numerous minute spines which become larger and stouter in the outer half of the arms.

The first brachial syzygy is always between brachials 3+4, and the first pinnule is always on the second brachial.

The earlier segments of the pinnules on the division series bear high carinate processes which are usually shaped like a thick T, and the opposite side of the segment is similarly produced. On P_1 the side of the basal segments toward the arm tips, beyond the first, is produced into a high narrow process of which the height is equal to about half the width of the segment which bears it and the width is equal to somewhat less than half the length of the segment. The processes on the second and third segments are more or less T-shaped with a more or less sharp crest parallel to the axis of the pinnule. Those on the succeeding segments are transversely broadened and thickly studded with short spines. After about the eighth segment these processes very slowly decrease in height and disappear after about the middle of the pinnule. Soon after this this border of the segments again slowly rises into a hump crowned with numerous short spines. As this hump increases in height it gradually moves to the outer side of the pinnule and becomes transformed into the teeth of the terminal comb. The terminal comb of P_1 has about 16 teeth which are high, practically oblong, and are separated from each other by about their own width. The earlier segments of P_1 have the side opposite that bearing the long processes thickened and armed with very numerous short spines, giving a strongly serrate profile. This feature decreases and disappears at about the end of the proximal third of the pinnule. On P_2, which is much smaller than P_1, the processes on the distal side of the earlier segments are narrower than those on P_1 and are curved more or less toward the pinnule tip. The processes on the opposite side of the segments are strongly developed. The comb consists of about 16 teeth which are high but very narrow, those at the tip of the pinnule becoming very small. P_3 resembles P_2. On P_4 and the following pinnules the processes on the side of the basal segments toward the arm base are absent, but those on the side toward the arm tip are strongly developed. These persist, in the form of spinous crests, to the terminal pinnules.

Another specimen has 40 arms. All of the division series are 4 (3+4). The dorsal pole of the centrodorsal is 7.5 mm. in diameter. The cirri have 29–30 segments.

In a specimen with 38 arms all the division series are 4 (3+4). The longest cirri have 34–38 segments and are up to 50 mm. long; most of the cirri have about 30 segments, and the smaller may be only 15 mm. long with 15 segments.

A specimen with 31 arms has the cirri with 18–21 segments.

In a specimen with 27 arms all the division series are 4 (3+4). The longest cirri have 28–32 segments.

Localities.—East of Flinders Island, Bass Strait, between Australia and Tasmania; 183–548 meters; *Endeavour*, December 3, 1913 [H. L. Clark, 1916] (2, M. C. Z., 710; Austr. M.).

Endeavour; off the coast of Gippsland, Victoria, southwest of Rame Head (lat. 38° 15′ S., long. 149° 20′ E.); 274–475 meters; September 19, 1914 (5). Pl. 23, fig. 62; pl. 69, figs. 190, 191.

Remarks.—As Doctor Clark says, this is a very well characterized and remarkable species of *Comanthus* which is related to *C. bennetti* and to *C. pinguis*, though easily distinguishable from both by the curious pinnule segments. The small number of arms and the color will further distinguish it from *C. bennetti*, while the shape of the arms, especially at the base, separate it from *C. pinguis*. From the south Australian *C. trichoptera* and its allies the size, the cirri, and the pinnules all sharply distinguish it.

COMANTHUS PINGUIS A. H. Clark

Plate 70, Figures 192, 193; Plate 71, Figure 194

[See also vol. 1, pt. 1, fig. 68 (section of centrodorsal and radial pentagon). p. 93; figs. 171, 172 (centrodorsal), p. 231; fig. 329 (cirrus), p. 281; pt. 2, fig. 248 (arm), p. 199; fig. 386 (pinnule tip), p. 245; fig. 701 (disk), p. 341]

Actinometra, sp. McClendon, Bull. American Mus. Nat. Hist., vol. 23, 1906, p. 123 (Suruga Gulf and Sagami Sea; myzostomes).

Actinometra robustipinna A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 684 (type of intercostal union).

Comaster robustipinna A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 34, 1908, p. 305 (various localities in Sagami Bay; Suruga Gulf).

Phanogenia robustipinna A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus robustipinna A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus pinguis A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 147 (resembles *C. bennetti*, especially in regard to the centrodorsal and the cirri); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 19 (cirri compared with those of *Comissia littoralis*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 7 (general appearance similar to that of *Comantheria grandicalyx*); p. 9 (35° 12′ N., 159° 44′ E., 30 fathoms; 35° 07′ N., 139° 44′ E., 21 fathoms); Crinoids of the Indian Ocean, 1912, p. 94 (synonymy; localities).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour* 1909–1914, vol. 4, pt. 1, 1916, pp. 16, 17 (comparison with *C. plectrophorum*).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 49 (in key; range).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol 5, No. 6, 1922, p. 46 (Bock's stations 14, 15, 18; notes); figs. 35, 36, p. 44; Zool. Bidrag från Uppsala, vol. 9, 1924, p. 11 (forked pinnule); p. 21 (Mortensen's station 10; distal pinnule replaced by an arm); p. 39, footnote (disk reaches to IIIBr$_2$ or $_4$); fig. 4, p. 13; figs. 135–138, p. 95 (pinnule articulations); Vidensk. Medd. fra Dansk naturh. Foren., vol. 83, 1927, p. 10 (localities; notes).

Comanthus (*Comanthus*) *pinguis* A. H. Clark, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 29 (Sagami Bay, Japan).

Comanthus japonica A. H. Clark, Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); p. 180 (8 miles outside Hong Kong; notes).

Comanthus (*Bennettia*) *pinguis* A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance).

Diagnostic features.—The centrodorsal is large and more or less hemispherical, with the dorsal pole concave. The cirri are numerous, large, and stout, with 25–38 (most commonly 28–34) segments of which the terminal 10 or 14 are about twice as broad as long with the dorsal side carinate and, in lateral view, produced into an angular prominence. The arms are 25–49 (most commonly about 40) in number, up to 200 (usually about 150) mm. long.

The broad and flattened division series of this species, combined with the large and prominent centrodorsal and the numerous long and stout cirri with short carinate distal segments, giving the cirri as a whole a serrate or scalloped distal dorsal profile, are very characteristic, and as a rule this species is readily recognizable at a glance.

Description.—The centrodorsal is large and hemispherical, from 10 to 12 mm. in diameter, with a slightly concave polar area usually about 7 mm. across furnished with a shallow median pit. The cirrus sockets are marginal, arranged in 3 or 4 closely crowded alternating rows.

The cirri are XXVIII–LVIII (usually XXXV–XLV), 25–38 (most commonly 28–34), from 30 to 40 mm. in length, large, and stout. The first segment is short, the second is about twice as broad as long, and the following gradually increase in length to the sixth, seventh, or eighth, which is about as long as broad. The next 3 or 4 segments are about as long as broad or slightly longer than broad, and those succeeding gradually decrease in length so that the terminal 10 or 14 are about twice as broad as long. At about the twelfth segment the distal dorsal edge begins to project, sometimes only in the median line but more commonly in a broad gablelike ridge with the apex in the center of the distal end of the segment. Distally this ridge narrows while at the same time the dorsal surface of the segments becomes carinate progressively farther and farther back so that in a lateral view the dorsal profile of the cirri distally presents a notched or scalloped appearance. Toward the tip of the cirrus the highest point in the dorsal carination moves gradually from a terminal to a median position. The opposing spine is represented by a low median tubercle which is slightly more than a right angle in lateral view. The terminal claw is somewhat longer than the penultimate segment, moderately stout, and rather strongly curved basally, becoming more slender and less curved distally.

The segment upon which the distal dorsal edge first begins to be prominent is in reality a transition segment, though in most specimens it is not particularly marked as such. The short distal segments are, however, always more highly polished than the more proximal. The transition segment, when distinguishable, is usually about the twelfth.

The ends of the basal rays are visible as prominent tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal in the median line, but extend upward in the interradial angles as far as the distal fourth of the IBr_1 in the form of a broad triangle over the ends of the basal rays. The IBr_1 are short and broad with the proximal border convex due to the interradial triangles formed by the radials, four or five times as broad as the median length; the lateral edges are very short, meeting above the ends of the radials but diverging in their distal half at approximately a right angle, or forming a U-shaped gap. The IBr_2 (axillaries) are broadly pentagonal or almost triangular, rather more than twice as long as the IBr_1, about twice as broad as long, not in lateral contact. The IIBr series are 4 (3+4), broad, moderately rounded dorsally, exposing between them a strip of perisome usually equal to about one-third of their own width. The IIIBr series are 4 (3+4), usually nearly or quite all present. The IVBr series are 4 (3+4), but rarely present. The division series are all somewhat massive in structure.

The arms are 25–49 (usually about 40) in number, from 100 to 200 mm. in length. The first brachials are wedge-shaped, almost entirely united interiorly, about twice as broad as the exterior length. The second brachials are similar in size and shape, but are not in contact interiorly. The first syzygial pair (composed of brachials 3+4) is not quite so long as broad. The next 4 brachials are oblong, from two to two and one-half times as broad as long, and those succeeding rapidly become wedge-shaped and after the twelfth triangular and half again as broad as long. At the end of the first third of the arm the brachials gradually become wedge-shaped again and decrease in length, in the distal half of the arm being almost or quite oblong, three or four times as broad as long. After the fourth the brachials develop overlapping and finely spinous distal ends which become very prominent in the distal half of the arm. The arms usually increase somewhat in width up to the twelfth brachial, thence gradually tapering distally.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 21+22, and distally at intervals of 4 muscular articulations.

The disk is very large, from 30 to 42 mm. in diameter, and is naked. The anal tube is large, central, or subcentral. The mouth is submarginal, variable in position.

P_D is from 35 to 40 mm. in length, very stout basally but tapering rather rapidly as far as the ventral surface of the disk, then remaining of uniform width, moderately slender, though distinctly stouter than usual in this genus, and relatively stouter than in *C. bennetti*. It is composed of from 60 to 65 segments, all of which are somewhat broader than long, the enlarged basal segments being the shortest. The terminal comb is very long with 16–18 teeth which are small, vertically oval or almost circular, widely spearated, scarcely reaching in height half the width of the segments which bear them. The terminal 4 or 5 segments taper to a point and do not bear distinct teeth. P_P is 30 mm. long, similar to P_D but considerably less stout basally. P_1 is 25 mm. long, resembling P_P but considerably less stout basally; it is composed of about 45 segments. P_2 is from 10 to 12 mm. long, small, weak, and slender, with about 30 segments. P_3 is similar, but only 7 mm. long. P_4 is similar, 6 mm. long. P_5 and the following pinnules are without terminal combs, 5 mm. long with 16 segments of which the first 4 are not quite so long as broad and have their distal angles cut away, and the remainder are about as long as broad and smooth. After remaining uniform for some time the pinnules slowly increase in length and in the number of their component segments, the distal pinnules being 12 mm. long, slender, with about 30 segments of which the first 2 are short and the remainder are about as long as broad. The second-fourth or -fifth segments of the middle pinnules are slightly produced dorsally, giving the dorsal profile of these pinnules a serrate outline. The outer surface of the pinnule segments is finely spinous, but the distal ends are not overlapping.

The color in alcohol varies from white to dark brown, often with a dark lateral line on the division series and arms.

Notes.—In the specimen from off Hong Kong Harbor the cirri are XXVIII 31–34, from 35 to 40 mm. in length. The segments in the outer half are broader than long, highly polished, and bear high and sharp carinate processes. There are about 40 arms 150 mm. long. All of the division series are 4 (3+4).

This specimen appears undoubtedly to be referable to *Comanthus pinguis*, although the distal edges of the brachials and of the elements of the division series are less prominent than usual and the cirri are rather longer and more slender than is ordinarily the case. It agrees well, however, with specimens at hand from various localities in southern Japan.

The small number of arms and the processes on the distal cirrus segments distinguish it from the variety of *Comanthus bennetti* occurring at St. Matthias Island.

All 3 of the specimens from northeast of Swatow are very large. One has 42 arms. Another apparently has 41 arms; the cirri have 31–33 segments and are 40 mm. long. The third is similar to the other two.

The specimen from south of the Goto Islands consists of a centrodorsal and arm bases. There apparently were about 40 arms.

One of the specimens collected by Captain Christiansen between the Goto Islands and Nagasaki has 40 arms. One IIIBr series is missing, the loss being compensated by the development of a IVBr series on the inner side of a IIIBr series. One of the IIBr series is 2, all of the other division series being 4 (3+4). The disk is 40 mm. in diameter. Another specimen has 42 arms. A third has 41 arms; there is a single IVBr series developed on the outer side of a IIIBr series. All of the division series are 4 (3+4). Of the 2 remaining specimens 1 is of enormous size. All of these specimens are of a more or less brownish yellow, usually brown on the dorsal surface of the division series and sometimes dark brown on the dorsal surface of the arms for part of their length.

In 1 of the 2 specimens from Bock's station 14, as described by Gislén, the centrodorsal is almost hemispherical, 9 mm. in diameter. The free dorsal pole is 5 mm. in diameter, and is a little hollowed in the middle. The cirri are arranged in 2 rows.

The cirri are XXXVIII, 28–33, from 30 to 36 mm. in length. The first and second segments are short, the third-fifth are about as long as broad or slightly longer than broad, and the sixth-tenth are half again as long as broad. The distal segments are twice as broad as long. The dorsal processes begin from the fifteenth to the twentieth segment. Their height is equal to about one-fifth the width of the segments. There is a weak opposing spine. The terminal claw is half again as long as the segment which bears it, and is slightly curved.

The radials are partially visible in the interradial angles. The IBr_1 are four times as broad as long, and are united in the proximal half. Just above their point of union there is a pit in the dorsal perisome. The IBr_2 (axillaries) are three times as broad as long, pentagonal, with the distal edges slightly concave. They are from 6.5 to 7 mm. in width. The IIBr and IIIBr series are 4 (3+4). The division series are broad, smooth, and flattened, but the dorsal perisome is quite visible between them. The first ossicles following each axillary are united interiorly, there being beyond the point of union a pit in the perisome.

The 38 arms are 125+ mm. long. The brachials are distally somewhat, but only slightly, thickened. There are 16 brachials for each 10 mm., or 13 if the syzygial pairs are counted as units.

The first brachial syzygy occurs between brachials 3+4. The second is from between brachials 6+7 to between brachials 8+9, but is commonly omitted. The third, which on many arms is the second, is from between brachials 14+15 to between brachials 21+22. The distal intersyzygial interval is 4 muscular articulations.

P_D is 30 mm. long and is composed of 50–55 segments, of which the terminal 5 do not bear teeth. The comb is composed of 20 low thin teeth which in length are equal to about one-quarter the width of the segments which bear them. The pinnule on the IIIBr series is about 25 mm. long and is composed of 45 segments the terminal 6 of which do not bear teeth. The comb is composed of 15 teeth. P_1 is 22 mm. long with 45 segments, of which the last 5 do not bear teeth. The comb is composed of 15 teeth. P_2 is 10 mm. long and carries a comb with 8 teeth. P_3 is 8 mm. long and bears a comb with 6 teeth. P_4 and P_5 usually bear a rudimentary comb. The distal pinnules are 10 mm. long with about 25 segments.

The disk is 32 mm. in diameter, reaching to the $IIBr_2$ or $IIBr_3$. It is without granules. The mouth is adradial. The anal cone is 6 mm. long.

The color is dorsally light yellow, ventrally yellow red, with a sharp dividing line, especially on the sides of the division series.

The other specimen from Bock's station 14 has the centrodorsal 9 mm. in diameter and 2 mm. high. The dorsal pole is rather flat, 6 mm. in diameter.

The cirri are XXXIV, 28–31, from 30 to 38 mm. long.

The elements of the division series are a little thickened at the articulations, and therefore the arm bases are not quite as smooth as in the preceding specimen.

The 38 arms are 140 mm. in length.

P_D is from 35 to 42 mm. long with about 50 segments, of which the 5 or 6 terminal are smooth. The comb is composed of 16 teeth. The pinnule on the IIIBr series is 30 mm. long. P_1 is about 25 mm. long, and has the last 3 segments smooth. Its comb has 13 teeth. The comb of P_2 has 8 teeth. P_3 is 7 mm. long, and carries a comb with 6 teeth. P_4 and P_5 are a little shorter than P_3, and also bear combs. P_6 is longer and is without a comb.

The disk is 32 mm. in diameter. The anal funnel is 5 mm. high. The color is as in the preceding specimen, but the disk is spotted with olive brown.

In the specimen from Bock's station 15, the centrodorsal is 8 mm. in diameter, with the dorsal pole 5 mm. in diameter. The cirri are XXXII, 23–28, from 18 to 25 mm. long. The dorsal spines are a little stronger than in the preceding specimens.

The IBr_2 (axillaries) are three times as broad as long, with the distal angle somewhat produced. They are 6 mm. in breadth.

The 32 arms are 115 mm. long. The interspaces between the $IIBr_3$ are 2.5 mm. broad. The division series are somewhat more slender than those of the preceding specimens.

P_D is from 26 to 33 mm. long and is composed of about 45 segments, of which from 5 to 14 bear teeth, though the terminal segments are smooth. The pinnule on the IIIBr series, or P_1, is 23 mm. long, and bears a comb consisting of about 10 teeth. P_2 is 18 mm. long and bears a comb of 8–9 teeth. P_3, P_4, and P_5 bear a small short comb of 3–5 teeth. P_6 is 5.5 mm. long with 18 segments, and has no comb.

The disk is 28 mm. in diameter. The anal tube is 4.5 mm. high. In color this specimen is a little more grayish brown than the 2 preceding.

The 16 specimens from Mortensen's station 10 have the following characters:

The centrodorsal is 9 mm. in diameter, with the dorsal pole 5 mm. in diameter. The cirri are XXVII, 26–30, from 27 to 32 mm. long. The 38 arms are 100+ mm. long. The width of the $IIBr_1$ is 3.8 mm. There is an interspace between the $IIBr_1$ of adjacent rays 1 mm. broad. P_D is about 25 mm. long with a comb of 19 teeth and a smooth tip. The pinnule on the IIIBr series is about 15 mm. long. P_1 is 4.5 mm. long. Combs occur as far as P_2 or P_3. The disk is 30 mm. in diameter.

The cirri are XXXII, 23–31, from 25 to 35 mm. long. The 28 arms are 100 mm. long. The width of the $IIBr_1$ is 3.8 mm. The interspace between the $IIBr_1$ on adjacent rays is 1.5 mm.

The cirri are XXXV, 28–30, from 25 to 36 mm. in length. The 32+ arms are 100+ mm. long. The width of the $IIBr_1$ is 4 mm. The interspace between the $IIBr_1$ on adjacent rays is 0.6 mm. broad. The disk is 24 mm. in diameter.

The cirri are XXXV, 30–35, from 28 to 35 mm. long. The 40 arms are 120 mm. long. The disk is 30 mm. in diameter.

The cirri are about XL, 33–34, up to 42 mm. in length. There are 39 arms, all of which are broken. The width of the $IIBr_1$ is 5.3 mm. The division series are in lateral apposition. The disk is 35 mm. in diameter.

The cirri are about XXXV, 33, 35 mm. long. The 38 arms are about 120 mm. in length. The width of the $IIBr_1$ is 5 mm. The interspace between the IIBr series is 0.5 mm. broad. One of the rays is abnormal (see beyond, under "Abnormal specimens"). P_D is 38 mm. long. The pinnule on the IIIBr series is 27 mm. long.

P_1 is from 15 to 20 mm. long. P_4, like all the preceding pinnules, bears a comb. The disk is 30 mm. in diameter.

The cirri are about XL, 27–32, from 25 to 36 mm. long. The 38 arms are 100+ mm. long. The width of the $IIBr_1$ is 4.5 mm. The interspace between the IIBr series is 1.3 mm. broad. The disk is 38 mm. in diameter. The color is dark.

The cirri are about XXX, all broken. The 38 arms are all broken. The width of the $IIBr_1$ is 3.8 mm. The interspace between the IIBr series is 1 mm. broad. One of the P_1 is lacking (see beyond, under "Abnormal specimens"). The disk is 30 mm. in diameter, and extends to the $IIIBr_3$, or the third brachial of arms arising from a IIBr series.

The cirri are about XL, 26–28, from 25 to 32 mm. long. The diameter of the centrodorsal at the base is 11 mm., the dorsal pole being 7 mm. across. The 40 arms are all broken. The width of the $IIBr_1$ is 4.5 mm. The interspace between the IIBr series is 0.8 mm. broad.

The dorsal pole of the centrodorsal is 3.5 mm. in diameter. The cirri are XXIV, 19–29, from 16 to 30 mm. in length. The 23 arms are about 95 mm. long. The width of the $IIBr_1$ is 3 mm. The interspace between the IIBr series on adjacent rays is 2 mm. broad. Combs occur as far as P_5. The disk is 15 mm. in diameter. One of the postradial series is undergoing multiplicative regeneration. It bears 2 IIBr series, and 4 IIIBr series, all 4 (3+4). The total length is 15 mm., the undivided arms being 10 mm. long and 0.7 mm. broad. P_2, P_3, and P_4 are rudimentary.

The cirri are about XL, 26–32, from 25 to 38 mm. long. The 49 arms are all broken. There are 9 IVBr series. On 1 ray, which is shown by Gislén as an example of the arm branching in this specimen, there are 2 IIBr 4 (3+4) series and 4 IIIBr 4 (3+4) series; of the latter the 2 inner each bear 2 IVBr 4 (3+4) series. The $IIBr_1$ are 5 mm. broad. The interspace between the IIBr series on adjacent rays is 1 mm. broad. P_D is 35 mm. long, and carries a comb consisting of 15 teeth. P_5 bears a comb, like the pinnules preceding. The disk is 37 mm. in diameter. In color this individual is uniformly dark brown dorsally, with the pinnules yellow and the disk dark.

The cirri have 26–34 segments, and are from 25 to 45 mm. long. The 41 arms are all broken. There are 4 IVBr 4 (3+4) series. The disk is 30 mm. in diameter.

The cirri have 24–31 segments, and are from 25 to 30 mm. long. The 35 arms are 125 mm. long. There is a single IIIBr 2 series. The disk is 23 mm. in diameter. The anal area is granulated.

The cirri have 25–34 segments, and are from 28 to 40 mm. long. The 34 arms are 130 mm. long. One of the IIBr series is 1, 2 are 2, and the remaining 6 are 4 (3+4). The IIIBr series are all 4 (3+4). The $IIBr_1$ are 4.5 mm. broad. The interspace between the IIBr series on adjacent rays is 1.5 mm. broad. The disk is 28 mm. in diameter. The anal cone is 7.5 mm. broad and 5 mm. high.

The cirri have 24–28 segments, and are from 26 to 35 mm. long. The 33 arms are 100 mm. long. The disk is 18 mm. in diameter.

The centrodorsal is discoidal, 4 mm. in basal diameter, with the free dorsal pole 2.5 mm. in diameter. The cirri are XXIX, 23–27, from 22 to 25 mm. in length. The 30+ arms are 95 mm. long. The $IIBr_1$ are 2.5 mm. broad. The interspace between adjacent IIBr series is 1 mm. broad. Two postradial series are in process of multiplicative regeneration. P_4 and the preceding pinnules have a low and often indistinct comb. The distal pinnules are 10 mm. long and have 24 segments. The diameter of the disk is about 14 mm.

In a young specimen from Bock's station 18 which Gislén with some doubt assigned to this species the cirri are XII, 10–12, from 2.5 to 3 mm. long. The third-fifth segments are the longest, half again as long as broad.

The radials are three times as broad as long. The IBr_1 are twice as broad as long and are laterally free. The IBr_2 (axillaries) are half again as broad as long, pentagonal, with the distal margins straight.

The 10 arms are 7 mm. long. The first brachials are almost free interiorly. The brachials distally are spiny and overlapping.

P_1 has an indistinct comb. The tip of the pinnule is smooth. The comb consists of 7 low and obtuse well separated teeth. The second-fourth or -fifth pinnules are lacking.

The disk is 2.3 mm. in diameter. The mouth and anus are subcentral. The anal cone is 1 mm. high. The disk is rather "lean," and is weakly papillated.

The specimen from Ito collected by Doctor Haberer in 1904 is typical, but much broken.

Of the 4 specimens from between Ito and Hatsushima one (4200) is a large example with 40 arms, all of the IIBr and IIIBr series being present. The dorsal side of the division series is more convex than usual, showing an approach to *C. japonica*. Another (4202) is a magnificent specimen with 37 arms 160 mm. long. The division series are exceptionally broad and massive. The cirri are 35 mm. long, stout, composed of 28–31 segments. The remaining 2 are typical. One (4209) has 35 arms 150 mm. long, and the cirri 35 mm. long.

Of the 3 specimens from Fukuura the 2 included in No. 4141 are typical examples with 40 and 37 arms about 150 mm. long. The third (4122, part) is large, with 34 arms. The division series are broad and massive. The cirri are large and stout, about 35 mm. long, and are composed of 33–35 segments.

The specimen from Aburatsubo (294) is a magnificent example with 40 arms 200 mm. in length. It is quite typical of the species.

Professor Doflein's specimen from Misaki (335) is small with 15 arms 45 mm. in length. One IIBr 4 (3+4) series is developed on each ray.

Of the specimens from *Albatross* station 3703, 1 has 39 arms about 140 mm. long, and the cirri about 40 mm. long. Of the remainder 4 are 10-armed young.

The specimen from Mortensen's station 16 has the cirri about XXX, 23–26, from 20 to 32 mm. long. The 26 arms are 105 mm. in length. The width of the $IIBr_1$ is 3.2 mm. The interspace between adjacent IIBr series on neighboring rays is 1 mm. The distal angle of the IBr axillary is very inconspicuously extended. The elements of the division series are rather strongly rounded dorsally. The pinnules as far as P_5 have combs. P_D is 21.5 mm. long and bears a comb consisting of 18 teeth. P_2 carries a comb of 12 teeth, the tip of the pinnule being smooth as usual. The comb of P_5 has 4 teeth. The disk is 26 mm. in diameter, and is without granules. The color is violet brown, the dorsal side of the arms with a narrow bright yellow longitudinal band.

Abnormal specimens.—In the individual from off Hong Kong the right anterior ray is very curiously developed.

On the right IIBr series (as viewed dorsally) the inner IIIBr series terminates in a doubled axillary—2 axillaries side by side—which forms an epizygal superposed upon the single hypozygal of the syzygial pair. Each half of this doubled axillary gives off 2 arms so that 4 arms arise from this single division series. Ventrally the ambulacral groove on reaching this axillary divides into 3 parts, 1 of which runs to the left (right as viewed dorsally) and soon divides, supplying 2 arms, while the other 2 run undivided to the 2 remaining arms.

The left IIBr series arising from this IBr series is undivided. It consists of only 9 brachials of which the last bears a single terminal pinnule of large size. The structure tapers regularly from the axillary to the base of the terminal pinnule. The third and fourth brachials are united by syzygy so that this arm stump bears 7 pinnules in all, 6 lateral on alternate sides of the arm and 1 terminal.

In a specimen from Mortensen's station 10, Gislén found a case of distal arm branching. The right posterior ray bears 2 IIBr 4 (3+4) series. The inner derivative from each is unbranched. The outer derivative of that to the right carries externally a IIIBr 4 (3+4) series bearing 2 undivided arms. The outer derivative of that to the left forks on the eighth brachial, which is the epizygal of the third syzygial pair, syzygies occurring between brachials 3+4, 5+6, and 7+8. Doctor Gislén interprets this as a case of an inner pinnule that has developed into an arm. But he says that here we get a picture of the repetition, as far as possible normal, in more distal parts of the arm of the proximal arm ramification and its distribution of nonmuscular articulations.

In another specimen from Mortensen's station 10, P_1 is lacking on an inner arm arising from a IIBr series.

Another specimen from the same station has 1 of the IIIBr series 2.

A fourth example from the same station has 1 of the IIBr series 1, 2 of them 2, and the remaining six 4 (3+4).

Remarks.—While in the great majority of cases this species has a very characteristic appearance and is readily distinguishable from all other comasterids, it seems to intergrade to a certain extent both with *C. japonica* and with *C. solaster.*

It is, perhaps, most easily confused with *C. trichoptera* which, however, has a discoidal centrodorsal with a broad flat dorsal pole and much more slender cirri.

Localities.—Eight miles outside Hong Kong Harbor (lat. 22° 12′ N., long. 114° 15′ E.); 25 meters; Captain Suensson, November 16, 1911 [A. H. Clark, 1913; Gislén, 1927] (1, C. M.).

Northeast of Swatow, China (lat. 23° 15′ N., long. 117° 40′ E.); Capt. H. Christiansen, July 26, 1912 (3).

South of the Goto Islands, Korean Straits (lat. 32° 15′ N., long. 128° 20′ E.); 183 meters; Capt. H. Christiansen, April 17, 1926 (1).

Between the Goto Islands and Nagasaki (lat. 32° 48′ N., long. 129° 37′ E.); 73 meters; bottom temperature 11.67° C.; Capt. H. Christiansen, S. S. *Nordiske*, April 23, 1912 (5).

Dr. Sixten Bock's expedition to Japan station 14; Goto Islands (lat. 33° 41′ N., long. 128° 50′ E.); 137 meters; sand; May 17, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 15; Goto Islands (lat. 33° 41′ N., long. 128° 50′ E.); 137 meters; sand; May 17, 1914 [Gislén, 1922].

Mortensen's station 10; same data as the station preceding, Doctors Mortensen and Bock having worked together [Gislén, 1924, 1927].

Dr. Sixten Bock's expedition to Japan station 18; off Okinoshima, Kiushiu; 91–110 meters; temperature 16.6° C.; May 18, 1914 [Gislén, 1922].

Albatross station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 58° E., 4.5 miles distant (lat. 30° 57′ 20″ N., long. 130° 35′ 10″ E.); 188 meters; stony bottom; temperature 15.89° C.; August 16, 1906 (3).

Albatross station 3701; Seno Umi bearing N. 10° W., 2.3 miles distant; 75–133 meters; May 7, 1900 (arm fragments).

Albatross station 3702; Seno Umi bearing N. 13° W., 1.5 miles distant; 57–75 meters; volcanic mud, sand, and rock; May 7, 1900 (arm fragments).

Albatross station 3703; Seno Umi bearing N. 16° E., 0.83 mile distant; 57 meters; volcanic sand and gravel; May 7, 1900 (4, M. C. Z., 208).

Albatross station 3707; Ose Zaki bearing S. 53° W., 2.25 miles distant; 115–137 meters; volcanic sand and gravel; May 8, 1900 (4).

Albatross station 3716; Ose Zaki bearing S. 36° W., 0.8 mile distant; 119–228 meters; volcanic sand, shells and rock; May 11, 1900 (4, U.S.N.M., 35147).

Albatross station 3718; Ose Zaki bearing S. 37° W., 1.2 miles distant; 119 meters; volcanic sand, shells and rock; May 11, 1900 (13, U.S.N.M., 35075, 35166). Pl. 70, figs. 192, 193.

Albatross station 3727; Omai Zaki bearing N. 17° E., 9.7 miles distant; 62 meters; mud, coarse sand, and broken shells; May 16, 1900 (7).

Albatross station 3730; Omai Zaki bearing N. 17° E., 14.5 miles distant; 62–68 meters; mud, gravel, and rock; May 16, 1900 (16, M. C. Z., 37, 207, 208).

Albatross station 3735; Omai Zaki bearing N. 15° E., 11.4 miles distant; 66 meters; coarse gray volcanic sand and broken shells; May 16, 1900 (8).

Albatross stations 3716–3735; Sagami Bay; May 11–16, 1900 [A. H. Clark, 1909] (5, U.S.N.M., 35146, 36287 [type; original type number 25517]). Pl. 71, fig. 194.

Sagami Bay (lat. 35° 06′ N., long. 139° 42′ E.); 55 meters; Alan Owston, April 24, 1902; original No. 7215 [A. H. Clark, 1908] (1).

Sagami Bay (lat. 35° 06′ N., long. 139° 42′ E.; or lat. 24° 59′ N., long. 139° 33′ E.); 55 or 110 meters; Alan Owston (1, U.S.N.M., 35148).

Sagami Bay (lat. 35° 07′ N., long. 139° 44′ E.); 38 meters; Alan Owston [A. H. Clark, 1912] (1, H. M.).

Sagami Bay (lat. 35° 12′ N., long. 139° 44′ E.); 55 meters; Alan Owston [A. H. Clark, 1912] (1, H. M.).

Sagami Bay (lat. 35° 11′ N., long. 139° 45′ E.); 91 meters; Alan Owston, June 30, 1901; original No. 6147 [A. H. Clark, 1908] (1, U.S.N.M., 35013).

Mortensen's station 16; Sagami Bay; 183 meters; June 6, 1914 [Gislén, 1927].

Ito; Doctor Haberer, 1904; original No. 9302 (1, Munich Mus.).

Between Ito and Hatsushima; about 150 meters; Doctor Haberer, March, 1903; original Nos. 4200, 4202, 4204, 4209 (4, U.S.N.M., 35757, 35760; Munich Mus.).

Fukuura; about 150 meters; Doctor Haberer, March 1–12, 1903; original Nos. 4141, 4122 (part) (3, U.S.N.M., 35768; Munich Mus.).

Aburatsubo; Prof. Franz Doflein, 1904; original No. 294 (1, Munich Mus.).

Misaki; Prof. Franz Doflein, 1904–5; original No. 335 (1, Munich Mus.).

Off Yenoshima; Alan Owston, March 27, 1905; original No. 9275 [A. H. Clark, 1908] (2, U.S.N.M., 35019, 35156).

Off Yenoshima; probably 91 meters; Alan Owston, May 15, 1902; original No. 7217 (A. H. Clark, 1908] [1, U.S.N.M., 35160).

Suruga Gulf; Alan Owston, April 12, 1903; original No. 7892 [A. H. Clark, 1908] (1, U.S.N.M., 35070).

Suruga Gulf and Sagami Sea [McClendon, 1906]. This refers to the *Albatross* stations from 3701 to 3735 listed above.

Japan; H. Loomis (1, U.S.N.M., 36168).

Albatross station 5095; in Uraga Straits, at the entrance to Tokyo Gulf; Joga Shima light bearing N. 28° W., 3 miles distant (lat. 35° 05′ 34″ N., long. 139° 38′ 36″ E.); 106 meters; temperature 14.33° C.; fine black sand and broken shells; October 26, 1906 (1, U.S.N.M., 36073).

Geographical range.—From Hong Kong to the Korean Straits, and eastward to Tokyo Bay.

Bathymetrical range.—From 25 to 188 (?288) meters. The average of 25 records is 103 meters.

Thermal range.—From 14.33° to 16.6° C. The average of the 3 records is 15.61°C.

History.—The crinoids which were obtained by the *Albatross* off southern Japan in 1900 were originally sent to Dr. Hubert Lyman Clark, then professor of zoology at Olivet College, for determination. The myzostomes which he found on these he sent to Dr. Jesse F. McClendon for study. The very stout comasterids in the collection Doctor Clark simply designated as a species of *Actinometra*, and they are given as *Actinometra*, sp., in Doctor McClendon's report, which was published in 1906.

In 1907 Doctor Clark, now on the staff of the Museum of Comparative Zoölogy, was so kind as to turn over to me the *Albatross* crinoids from southern Japan, and among these I found numerous examples of a species which I identified with Carpenter's *Actinometra robustipinna*, originally described from the Moluccas.

In 1908 in a paper on the crinoid genus *Comatula* I mentioned the features of the union between the elements of the IBr series in *Actinometra robustipinna*. My idea of that form was based upon these comasterids from southern Japan.

Mr. Frank Springer in 1907 had purchased the crinoid collection of Mr. Alan Owston, of Yokohama, who had done a considerable amount of dredging from his yacht the *Golden Hind*, and had presented it to the National Museum. In another paper published in 1908 I recorded this species, as *Comaster robustipinna*, from 5 localities in Sagami Bay and Suruga Gulf where it had been dredged by Mr. Owston in 1901–1905.

I soon discovered that this form is not the same as Carpenter's *Actinometra robustipinna*, and in 1909 I described it as a new species under the name of *Comanthus* (*Comanthus*) *pinguis*.

In 1912 I recorded 2 specimens originally collected by Mr. Owston which I had examined in the Hamburg Museum.

In 1913 I recorded, as *Comanthus japonica*, a specimen which had been dredged by Captain Suensson off the harbor at Hong Kong.

In 1922 Dr. Torsten Gislén recorded this species from 3 of Dr. Sixten Bock's stations in southwestern Japan, in 1924 he mentioned and described an abnormal specimen from Dr. Th. Mortensen's station 10, and in 1927 he described in detail the material in Mortensen's collection, and at the same time pointed out that my specimen from Hong Kong identified as *japonica* should have been referred to this form.

COMANTHUS JAPONICA (J. Müller)

Plate 71, Figure 195; Plate 72, Figures 196-198; Plate 73, Figure 201; Plate 82, Figures 226, 227

Alecto japonica J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 186 (description; Japan); Archiv f. Naturgesch., 1841, vol. 1, p. 145 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 216.—A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (identity).

Comatula japonica J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 260.—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 206 (synonymy; description; Japan).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (can not place either in *Antedon* or *Actinometra*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 154 (comparison of cirri with those of *C. solaster*); Crinoids of the Indian Ocean, 1912, p. 30 (identity).

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Comanthus solaster Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol 5, No. 6, 1922, pp. 43–46 (Bock's stations 20, 28, 38; notes); figs. 33, 34, p. 44.

Comanthus solaster forma *multicirra* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 46 (diagnosis; Bock's stations 20, 28, 38A).

Comanthus japonicus Gislén, Vidensk. Medd. fra Dansk naturh. Foren., vol. 83, 1927, p. 13 (Mortensen's stations 1, 27; notes).

Diagnostic features.—In large specimens the centrodorsal is large and more or less hemispherical, with the dorsal pole concave. The cirri are numerous, large and stout, with 19–36 (usually about 30) segments of which the terminal 10 or 12 are from one-third again to twice as broad as long and bear dorsally a subterminal tubercle or blunt spine. The arms are 13–50 (usually 30–40) in number, from 80 to 180 mm. (usually from 100 to 150 mm.) in length. The division series are narrow and very strongly convex dorsally, and are widely separated laterally.

Apparently fully developed specimens are frequent in which the cirri have about 20 segments and the arms are 20–25 in number.

Excepting for its narrow and widely separated division series this species in all respects very closely resembles *C. pinguis.*

Description.—The centrodorsal is discoidal, moderately thick, with the polar area broad, flat, or slightly concave, from 4 to 6 mm. in diameter. The cirrus sockets are arranged in 2 closely crowded alternating, but more or less irregular, marginal rows.

The cirri are XX–L (usually XX–XXX), 19–23 (usually 20), from 17 to 23 mm. long. They are moderately stout, well rounded in cross section in the proximal half but laterally compressed in the distal half and therefore appearing in lateral view broader distally than proximally. The first segment is short, the second is longer, the third is about as long as broad, and the fifth-seventh are nearly or quite twice as long as broad. The segments following decrease in length so that the last 8 or 10 are from one-third to one-half again as broad as long. The seventh or eighth is usually a well-marked transition segment. The transition and following segments have the dorsal portion of the distal edge somewhat thickened, this soon becoming a small subterminal tubercle. The opposing spine is a low but usually sharp tubercle with the apex varying from median to terminal, though commonly nearer the former. The terminal claw is considerably longer than the penultimate segment, and is slender and relatively slightly curved.

The radials are concealed by the centrodorsal. The IBr_1 are oblong, short, about four times as broad as long, and entirely free laterally. The IBr_2 (axillaries) are triangular, twice as broad as long, with the anterior angle rather sharp. The

IIBr series are 4 (3+4). The IIIBr series are 4 (3+4), but are rarely present. The division series are strongly rounded dorsally and laterally, and are widely separated laterally.

The arms are 13–40 (usually 20–25) in number, and from 80 to 120 mm. in length. The first 2 brachials are subequal, slightly wedge-shaped, twice as broad as the exterior length. The first brachials are interiorly united basally. The first syzygial pair (composed of brachials 3+4) is oblong, from half again to twice as broad as long. The next 3 or 4 brachials are oblong, twice as broad as long, those succeeding becoming triangular, nearly as long as broad, and after about the middle of the arm wedge-shaped and half again as broad as long. The fourth and following brachials have somewhat produced and finely spinous distal ends.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 17+18, and distally at intervals of usually 4 muscular articulations.

P_D is 20 mm. long, rather stout basally but tapering rapidly in its proximal third and becoming slender and delicate distally. The segments in the enlarged proximal portion bear very high carinate processes which gradually die away as the pinnule becomes more slender. The terminal comb arises gradually. It is composed of 12–15 small, rounded and well separated teeth. P_1 is nearly as long as P_D, but is less stout basally. P_2 is 12 mm. long, similar to P_1 but much more slender. P_3 is 10 mm. long, and is small and weak. The following pinnules are similar in length to P_3 but are slightly stouter, soon very gradually increasing to about 12 mm. in length and becoming very slender distally. The second-fourth or second-fifth segments are more or less, usually strongly, carinate, this feature being especially marked on the genital pinnules, though often but little less marked on the distal pinnules. The terminal comb continues to P_4.

The disk is from 15 to 20 mm. in diameter, and is naked. The mouth is marginal, and varies in position from radial to interradial. The anal area is very large, and the anal tube is central.

The color is bright yellow to deep yellowish brown, in alcohol yellowish or brownish white, or yellowish or greenish brown.

The preceding description is based on a series of specimens collected by the *Albatross*. As will be seen from the following notes, this species sometimes reaches a much larger size and higher degree of development.

Notes.—Owston's specimen No. 7194 has the carination of the proximal pinnule segments much more marked than usual.

Owston's specimen No. 6929 approaches *C. solaster* in its characters. It has 20 arms.

Owston's specimen No. 6932, to which the depth assigned is doubtfully correct, approaches C. *pinguis*. It has 29 arms.

The specimen from Haidashi Bank has 35 arms. All of the division series are 4 (3+4). The cirri are large and stout with 29–31 segments, and are 35 mm. in length. The centrodorsal is thick discoidal, 8 mm. in basal diameter, with a broad flat dorsal pole in the center of which is the usual small pit. The division series are well separated.

Of the specimens from Ito, No. 9305 is a medium-sized example with 31 arms about 100 mm. long. The division series are well separated and are strongly rounded dorsally. The cirri are composed of 32–33 segments, and are 35 mm. in length. No. 9303 has 38 arms. No. 9302 is small and delicate, with 23 arms.

The specimen from between Ito and Hatsushima (4209) is small.

Of the 6 specimens from Fukuura in about 150 meters, No. 4113 is a typical example of the species, but greatly exceeds in size any other I have seen.

The centrodorsal is very large, thick discoidal, 12 mm. in basal diameter, and about 3 mm. in height. The dorsal pole is very broad, flat, with a small deep median pit. The cirrus sockets are arranged in 2 and a partial third closely crowded and irregular marginal rows.

The cirri are very large and long. They are from 40 to 50 mm. in length and are composed of 32–36 segments, of which the longest are about as long as broad and have a slightly concave ventral profile. The twelfth or thirteenth (usually the former) is a transition segment, beyond which the segments are about twice as broad as long and are highly polished. The segments distal to the transition segment have everted distal edges dorsally, this eversion being V-shaped in end view. The eversion gradually moves to a median position, and on the outer segments becomes a narrow, sharp, and high evenly rounded median keel. The opposing spine is transversely elongated or forked.

The 40 arms are about 180 mm. in length. All 10 IIBr series and all 20 IIIBr series are present, and all are 4 (3+4). The division series and arms resemble those of *C. bennetti.*

The proximal pinnules are very stout basally and very long, resembling those of *C. bennetti.*

The other 5 specimens are included in No. 4122. Of these, 2 are of medium size, 1 having 37 and the other 33 arms. Both are nearly white in color with the sides of the division series and arms brown.

A medium-sized specimen with 24 arms has the centrodorsal 8 mm. across the pentagonal base and 4 mm. across the irregular dorsal pole, the sides being strongly sloping. The color as preserved is white, with small isolated brown triangular spots along the sides of the division series and arms.

The 2 specimens from Fukuura without indication of depth are typical. One has exactly 40 arms.

The example from near Iagoshima is medium sized and typical, with the arms about 100 mm. long. It is just undergoing adolescent autotomy.

As described by Gislén, one of the specimens from Mortensen's station 1 has the cirri XXXVI, 16–21, from 8 to 15 mm. long. The fourth-seventh segments are the longest, from half again to twice as long as broad.

The 19 arms are 85 mm. in length. The radials are six times as broad as long. The IBr_1 are three or four times as broad as long, and are free laterally. The IBr_2 (axillaries) are twice as broad as long, and have the distal angle produced. The IIBr series are 4 (3+4). The $IIBr_1$ are 1.8 mm. in width. The division series are smooth and are close together, so that only narrow strips of the dorsal perisome and the pinnule bases can be seen between them.

P_D is 19.5 mm. long and bears a comb consisting of 10 very indistinct teeth; the tip is smooth. P_1 is 16 mm. long. P_2 is 9.5 mm. long and bears a very feebly developed comb. P_3 is 6 mm. long and is without a comb. The distal pinnules are 10.5 mm. long with 22 segments. On all the pinnules the second-fifth or -sixth segments have small prominences, and the terminal 3 or 4 bear dorsal hooks.

The disk is 17 mm. in diameter and is naked. The anal tube is central and is 4 mm. high. All the arms are grooved.

The color in alcohol is brown.

Another specimen from Mortensen's station 1 has the cirri XXXVII, 16–21, from 9 to 15 mm. long. The 18 arms are 65 mm. long. There are distinct interspaces between the proximal division series. The disk is 16 mm. in diameter.

In a third specimen from Mortensen's station 1 the cirri are XXII, 19–22, from 14 to 18 mm. in length. The 22 arms are about 80 mm. long. The division series are rather close together. The disk is 21 mm. in diameter.

The fourth specimen from Mortensen's station 1 has the centrodorsal 2 mm. in diameter. The cirri are XXVII, 15–19, from 8 to 12 mm. long. The 20 arms are 65 mm. in length. All of the arms are grooved. P_2 and the pinnules preceding bear combs. The anal tube is central and is inconspicuously inflated.

One of the specimens from Mortensen's station 27 has the cirri about XLII, 20–24, from 12 to 22 mm. long. The 35 arms are from 100 to 120 mm. long. The disk is 22 mm. in diameter.

In the other specimen from Mortensen's station 27 the cirri are about LV, 20–23, from 15 to 20 mm. long. The 36 arms are from 100 to 120 mm. long.

In the specimen from Bock's station 20 the centrodorsal is 10 mm. in basal diameter, with the bare dorsal pole 8 mm. across. The cirri are arranged in 2 rows.

The cirri are about LX, 20–24, from 14 to 23 mm. long.

The 40 arms are from 105 to 120 mm. in length. The IIBr and IIIBr series are 4 (3+4). The division series and arms resemble those in the first specimen from Bock's station 38.

P_D is 28 mm. long with about 50 segments. The pinnule on the IIIBr series is about 20 mm. long and bears a comb consisting of 6–8 very short teeth, the terminal 5–6 segments being smooth. P_1 is shorter. P_2 is about 10 mm. long. P_3 is 7 mm. long, and is without a comb. The distal pinnules are 9 mm. long.

The disk is 28 mm. in diameter. The anal tube is 6 mm. high.

In the specimen from Bock's station 28 the centrodorsal is 10 mm. in basal diameter, with the free dorsal pole 7 mm. across.

The cirri are LV, 20–26, from 12 to 22 mm. in length.

The IBr_1 are partly visible. The IBr_2 (axillaries) are almost triangular, and are half again as broad as long. The IIBr and IIIBr series are 4 (3+4). The sutures between the IIBr and IIIBr segments are slightly visible. The division series are not quite so smooth as in the first specimen from Bock's station 38.

P_D is 24 or 25 mm. in length, and is composed of about 55 segments of which 10–12 bear indistinct teeth which in height equal about one-third the width of the segments. The pinnule on the IIIBr series, P_1, and P_2 are shorter. P_3 bears a small comb. The genital pinnules are 10 mm. long. The distal pinnules are 11 or 12 mm. long.

The disk is 32 mm. in diameter. The anal tube is 6 mm. high.

In the first specimen from Bock's station 38 the centrodorsal is 11 mm. in basal diameter with the slightly concave dorsal pole 7.5 mm. across. The cirri are arranged in 2 or 3 rows.

The cirri are about LXX, 18–23, from 12 to 21 mm. in length. The cirri are very diversified, some being slender, straight, and weak, and others stout, thick, and strongly curved. In the slender and straight cirri the first segment is short, the second-third or -fourth are about as long as broad or a little longer, and the fifth-eighth are about twice as long as broad. From about the tenth segment onward they are twice as broad as long. In the large stout cirri the longest segments are only one-quarter again as long as broad. A dorsal transverse ridge or knot occurs from the twelfth or sixteenth segment onward. The terminal claw is rather stout, and is somewhat longer than the penultimate segment.

The radials and the IBr_1 are concealed by the centrodorsal. The IBr_2 (axillaries) are twice as broad as long, triangular, with the distal angle very acute and separating the very short inner ends of the $IIBr_1$. The IIBr, IIIBr, and IVBr series are all 4 (3+4). The first elements of the 2 last are interiorly united. The division series are closely appressed so that from the dorsal side only the first 6 segments of P_D are visible.

The 50 arms are from 110 to 130 mm. long. The brachials from the fourth to about the seventieth have the distal ends overlapping and armed with small spines, but the division series, first 3 brachials, and arm tips are smooth. There are 20–21 brachials to 10 mm., or 15–16 if the syzygial pairs are counted as units. The IIBr series are 4 mm. in diameter. The first brachial is 2.3 mm. broad; 50 mm. from the base the arm is 1.3 mm. broad.

Syzygies occur between brachials 3+4, 17+18, 23+24, or brachials 3+4, 14+15, 18+19, etc., and distally at intervals of 4 muscular articulations.

P_D is about 25 mm. long with about 60 segments, bearing a comb with 8–16 weak teeth, the last 2–5 segments being smooth. The basal segments are angular and a little beadlike. The pinnule on the IIIBr series is similar, but somewhat shorter. The pinnule on the IVBr series, or P_1 is about 20 mm. long and bears a comb consisting of 11 teeth. P_2 is still shorter, and bears a comb with 8 rudimentary teeth. P_3 is 6.5 mm. long, and is without a comb. The genital pinnules are 11 or 12 mm. long. The distal pinnules are of about the same length. On all the pinnules the second-fifth or -seventh segments have small processes.

The disk is 30 mm. in diameter, and is without granules. The mouth is marginal. The anal tube is subcentral and is 7 mm. high.

The other specimen from Bock's station 38 has the centrodorsal 10 mm. in basal diameter with the dorsal pole slightly concave, 6.5 mm. in diameter.

The cirri are LXV, 22–24, from 12 to 25 mm. in length.

The IBr_1 are ten times as broad as long. The IBr_2 (axillaries) are twice as broad as long. The IIBr, IIIBr, and IVBr series are 4 (3+4), 2 of the last being present.

The 42 arms are from 125 to 155 mm. long.

The disk is 32 mm. in diameter, and the anal tube is 8 mm. high.

The color, as in the preceding specimen, is violet brown with the cirri and regenerated portions somewhat lighter.

The specimen from Misaki collected by J. F. Abbott has 41 arms. All of the IIBr and all of the IIIBr series are present, and there is a single IVBr series which is on the inner branch of one of the inner IIIBr series. This specimen approaches *C. pinguis* in the broadness of its postradial structures, which are only separated laterally by the dorsal portion of P_1, so that the general appearance is more or less like that of *C. solaster*.

Mr. Owston's specimen from the Uraga Channel has 22 arms.

Professor Doflein's specimen from the entrance to Bayami is very large. It possesses exactly 40 arms.

Of the specimen from Tokyo Bay which he at first called *Actinometra morsei* Carpenter said that it was a little individual without IIIBr series. It has rather shorter axillaries than the type of *japonica*, and less developed spines on the distal cirrus segments, both of which features are points of resemblance with *trichoptera*. But Carpenter noted that it seems to have longer brachials than *trichoptera*, and it shows the carination of the large segments of the distal pinnules which in *japonica* extends farther out on the arm.

Under the name of *Actinometra japonica* var. *morsei* Hartlaub described a specimen which he believed to be the one, or at least very similar to the one, noticed by Carpenter as *morsei*.

It differs from the one Hartlaub determined as *trichoptera* in the conspicuous carination of the 4 large basal segments of P_D, and, according to Hartlaub, represents a deviation from the form represented by the type specimen.

The sharp distal angle of the axillaries which Carpenter gave as characteristic of *japonica* is strongly marked. The marked length of the axillaries which Carpenter also noted is only partially in evidence.

The IBr_2 (axillaries) are very short. The IIBr and IIIBr axillaries on the single ray on which a IIBr 2 and a IIIBr 2 series are present are also short. All of the other IIBr series are 4 (3+4), and their axillaries are markedly longer.

The specimen is broken, but the number of arms was certainly less than 20.

Hartlaub said that the most marked difference between this specimen and the type of *japonica* is that the carination of the pinnule segments is restricted to P_D.

A specimen from Tokyo Bay collected by Professor Morse and identified by Hartlaub as *Actinometra trichoptera* undoubtedly represents this species. The cirri are about XL, with the segments averaging 20. There are no IIIBr series. The arms are 20 in number. The brachials are short, with strongly produced distal ends. The distal intersyzygial interval is 4 muscular articulations. P_D shows no carination of the basal segments. The color is a uniform fairly dark brown.

Hartlaub said that this specimen much resembles in its color and in the characters of its brachials and proximal pinnules specimens of *Comanthus parvicirra* from Tokyo, but it differs from these, aside from the characters noted above, in that the cirrus segments from about the tenth onward bear a weak spine or tubercle dorsally and not a transverse ridge.

A specimen without locality which was described by Hartlaub as a new species under the name of *Actinometra spinipinna* evidently belongs to *C. japonica*, and probably is one of those collected by Professor Morse in Tokyo Bay.

The centrodorsal is of medium size with the border sloping sharply inward to the dorsal pole, which is slightly concave.

The cirri are XXXIX, 16–20. Beyond the 2 basal segments, the cirri have in the proximal half elongated segments which are somewhat constricted centrally. In the distal half the cirri are laterally compressed and the segments are much shorter. The outermost cirrus segments bear a small dorsal spine.

The radials are concealed beneath the cirri. The IBr_1 are short and free laterally. The IBr_2 (axillaries) are short and almost triangular with a rather strongly produced distal angle. The IIBr series are 4 (3+4). The distal angle of the IIBr axillaries is also produced. There is a single IIIBr 4 (3+4) series. The division series are not in lateral contact.

The 21 arms are composed of moderately short brachials. The first 5 brachials are more or less shortly discoidal, and those following are somewhat longer and triangular with everted and produced distal edges. Toward the end of the arms the brachials become short wedge-shaped and their distal edges are beset with small spines.

Syzygies occur between brachials 3+4, again from between brachials 10+11 to between brachials 13+14, commonly between brachials 11+12, and distally at intervals of 4 muscular articulations. Sometimes there is a syzygy between brachials 7+8.

P_D is about 10 mm. long, stout in the proximal half but very slender distally. The comb is short, and is confined to the distal end. The number of segments in the pinnule can not be determined because of the strong perisomic investment, which is also possessed by the pinnules following. The stout segments in the proximal portion bear a process covered with fine spines on the edge toward the arm tip. Similar processes occur on the second pinnule, while on the succeeding brachial pinnules there are developed in their place a few (2 or 3) spine pointed tubercules. The second pinnule is of the same character as the first, but it is somewhat smaller and its comb is less marked. The third pinnule is shorter and bears no comb. The length of the pinnules from the seventh brachial onward is very uniform—about 6 mm. The pinnule of the ninth brachial may be somewhat longer than 6 mm. From the seventh brachial on the pinnules are swollen genital pinnules, becoming slender again in the distal half of the arms.

The anal area and the anal opening carry no papillae.

The color in alcohol is in general light yellowish gray brown. In a closer view it is seen that the individual brachials are speckled and that toward the sides, as in their proximal portion, they are lighter.

Hartlaub considered this supposed new species to be near *trichoptera*.

The type specimen from Japan was thus redescribed by Dr. P. H. Carpenter.

The centrodorsal is broad, discoidal, and slightly hollowed in the center. It conceals the greater part of the radials and IBr series.

The cirri are about L, 20. The third segment is longer than broad, and the fifth is the longest. The following decrease slowly in length, the terminal ones being deep and much compressed and bearing small and blunt dorsal spines. The opposing spine is not especially large.

The IIBr and IIIBr series are 4 (3+4). The axillaries are long with sharp distal angles. The first segments beyond each axillary are only partly united laterally.

There are 27+ arms which are probably between 75 and 100 mm. long. The first and second brachials are both bluntly wedge-shaped, the first being the shorter and the second the more nearly oblong. The next 3 brachials are short and nearly oblong. Those following are both longer and broader, wedge-shaped, with overlapping distal ends. After about the fifteenth the width of the brachials decreases and they become more oblong, though still overlapping.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 15+16, and distally at intervals of 3–5 muscular articulations.

All of the lower pinnules are long, especially P_D, which reaches about 20 mm. in length. Those following diminish gradually in length, that on the sixth brachial being a good deal shorter than its predecessor (P_2), though still large. After this the pinnules are stouter and tolerably uniform in length, eventually becoming longer and more slender. The large lower pinnules have sharp keels on the 6 or 7 basal segments. After the fifth or sixth brachials this carination is confined to the first 4 segments, dying away altogether after about the twentieth brachial. The lowest pinnules, as far as the fifth brachials, have terminal combs.

The disk is 25 mm. in diameter, and is naked. The mouth is interradial.

I personally examined this specimen in 1910. The numerous cirri are rather strongly curved distally. The dorsal pole of the centrodorsal is very broad. The division series are rather broad, and the axillaries are long and acutely pointed, suggesting the conditions found in *C. trichoptera*.

Abnormal specimens.—In the specimen from Tokyo Bay described by Hartlaub as var. *morsei* one of the rays carries a IIBr 2 series, and a IIIBr 2 series.

In the very large specimen from Fukuura (4113) the opposing spine is transversely elongate or forked.

Remarks.—Although in most cases individuals of this species are at once distinguishable from examples of the closely related forms, specimens may sometimes be found which intergrade with both *C. pinguis* and *C. solaster*. Outside of these 2 species its closest relationships are with the south Australian *C. trichoptera* and its allies.

Localities.—Eastern Asia; Captain Suensson, April 19, 1911 (2, C. M.).

Albatross station 4895; Eastern Sea, off Kagoshima Gulf; Ose Saki light bearing N. 42° E., 4.7 miles distant (lat. 32° 33′ 10″ N., long. 128° 32′ 10″ E.); 174 meters; green sand, broken shells, and pebbles; August 9, 1906 (1).

Albatross station 4894; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 41° E., 5 miles distant (lat. 32° 33′ 00″ N., long. 128° 32′ 10″ E.); 171 meters; temperature 13.28° C.; green sand, broken shells, and pebbles; August 9, 1906.

Albatross station 4890; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 2° W., 10 miles distant (lat. 32° 26′ 30″ N., long. 128° 36′ 30″ E.); 243 meters; temperature 11.28° C.; rocky bottom; August 9, 1906 (1, U. S. N. M., 35162).

Albatross station 4878; in the eastern channel of the Korean Straits, near the Oki Islands; Oki Shima bearing S. 58° W., 7 miles distant (lat. 34° 18′ 30″ N., long. 130° 14′ 30″ E.); 106 meters; temperature 16.72° C.; fine gray sand and broken shells; August 2, 1906 (1, U. S. N. M., 35068).

Albatross station 4934; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 77.5° E., 7 miles distant (lat. 30° 58′ 30″ N., long. 130° 32′ 00″ E.); 188–278 meters; rocky bottom; August 16, 1906 (fragments).

Albatross station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 58° E., 4.5 miles distant (lat. 30° 57′ 20″ N., long. 130° 35′ 10″ E.); 185 meters; temperature 15.89° C.; stony bottom; August 16, 1906 (3, U. S. N. M., 35009, 35022, 35023). Pl. 71, fig. 195.

Albatross station 3703; Sagami Bay; Seno Umi bearing N. 16° E., 0.8 mile distant; 56 meters; volcanic sand and gravel; May 7, 1900 (6, U.S.N.M., 35057).

Albatross station 3707; Ose Zaki light bearing S. 53° W., 2.25 miles distant; 113–135 meters; volcanic sand and gravel; May 8, 1900 (5, U.S.N.M., 35028). Pl. 72, figs. 197, 198; pl. 82, fig. 224.

Albatross station 3716; Ose Zaki light bearing S. 36° W., 0.8 mile distant; 119–228 meters; volcanic sand, shells and rock; May 11, 1900 (1, U.S.N.M., 35118).

Albatross station 3730; Omai Zaki light bearing N. 17° E., 14.5 miles distant; 62–68 meters; mud, gravel and rock; May 16, 1900 (1, M. C. Z., 39).

Sagami Bay (lat. 35° 03′ N., long. 138° 47′ E.); 201 meters; Alan Owston, August 15, 1902; original No. 7011 [A. H. Clark, 1908] (1, U.S.N.M., 35099).

Sagami Bay (lat. 35° 04′ N., long. 138° 48′ E.); 146 meters; Alan Owston, August 10, 1902; original No. 7194 [A. H. Clark, 1908] (1, U.S.N.M., 35061).

Sagami Bay; 548 meters (depth very doubtful); Alan Owston, May 5, 1902; original No. 6932 [A. H. Clark, 1908] (1, U.S.N.M., 35003). Pl. 72, fig. 196.

Sagami Bay (lat. 35° 11′ N., long. 139° 44′ E.); 256 meters; Alan Owston, May 25, 1902; original No. 6929 [A. H. Clark, 1908] (1, U.S.N.M., 35100).

Sagami Bay; Haidashi Bank; 200 meters; Prof. Franz Doflein, 1904–05; original No. 301 (1, U.S.N.M., 35759).

Ito; Doctor Haberer, 1904; original Nos. 9302, 9303, 9305 (3, Munich Mus.).

Between Ito and Hatsushima; about 150 meters; Doctor Haberer, March, 1903; original No. 4209 (1, Munich Mus.).

Fukuura; about 150 meters; Doctor Haberer, March 1–12, 1903; original Nos. 4113, 4122 (6, Munich Mus.). Pl. 73, fig. 201.

Fukuura; Doctor Haberer, February 10–20, 1903; original Nos. 4142, 4143 (2, U.S.N.M., 35763 [4142]; Munich Mus.).

Near Iagoshima; 150 meters; Prof. Franz Doflein, October 31, 1904; original No. 327 (1, U.S.N.M., 35780).

Mortensen's station 1; at the Biological Station, Misaki; shore; April 23, 1914 [Gislén, 1927].

Mortensen's station 27; Misaki; 1.8 meters; rocky bottom; July, 1914 [Gislén, 1927].

Dr. Sixten Bock's expedition to Japan station 20; Misaki; 2 meters; May 19, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 28; Misaki; 2–3 meters; rocky bottom; June 14, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 38; Misaki; 2–4 meters; rocky bottom; July 9, 1914 [Gislén, 1922].

Near Misaki; Prof. Bashford Dean [Kirk, 1911] (11, U.S.N.M., 35058).

Misaki; 219 meters; Alan Owston; original No. 6802 (1, U.S.N.M., 35043). Pl. 82, fig. 225.

Misaki; J. F. Abbott (1, L. S.).

Misaki [Hara, 1895]. Same [Mortensen, 1920].

Uraga Channel, at the entrance of Tokyo Gulf; 46 meters; Alan Owston, June 16, 1901 [A. H. Clark, 1908] (1, U.S.N.M., 35024).

Uraga Channel; entrance to Bayami; 135 meters: Prof. Franz Doflein, October 29, 1904; original No. 289 (1, U.S.N.M., 35758).

Tokyo Bay; Prof. Edward S. Morse [P. H. Carpenter, 1881, 1888; von Graff, 1884; Hartlaub, 1912] (9, M. C. Z., 195; B. S.).

Japan; von Siebold [J. Müller, 1841, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1879, 1881, 1883, 1888; Bell, 1882; A. H. Clark, 1911] (1, L. M.).

No locality (probably Tokyo Bay) [Hartlaub, 1912].

Erroneous locality.—Eight miles outside Hong Kong harbor (lat. 22° 12′ N., long. 114° 15′ E.); 25 meters; Captain Suensson, November 16, 1911 [A. H. Clark, 1913; Gislén, 1927] (1, C. M.). This is a specimen of *C. pinguis*.

Geographical range.—Southern Japan, from the Korean Straits eastward to Tokyo Bay.

Bathymetrical range.—From the shore line down to 256 meters. The average of 28 records is 76 meters.

Thermal range.—From 11.28° to 16.72° C. The average of 4 records is 14.29° C.

Occurrence, habits, etc.—Dr. Edwin Kirk remarked on the preponderance of females over males in this species. He wrote that among nearly 30 individuals collected at a single locality (near Misaki) there were no males. The females in all cases bore large numbers of ripe ova.

Doctor Kirk's observations on the food of this species were given in volume 1, part 2, on page 613.

While searching for the pentacrinoids of *Compsometra serrata* on the rocky shores near the biological station at Misaki Dr. Th. Mortensen found a single 20-armed specimen of this species. He noted, however, that it is abundant in other localities near the biological station.

History.—This species was originally described as *Alecto japonica* by Johannes Müller in 1841. Muller's description was based upon notes taken by Troschel on a specimen in the Leyden Museum which had been collected by von Siebold in Japan. In 1849 Müller repeated the original description without change under the name *Comatula japonica*.

Dujardin and Hupé in 1862 published a translation of Müller's description of 1841.

In 1879 Dr. P. H. Carptenter listed 7 species which he was unable to assign either to *Actinometra* or to *Antedon* because the descriptions were inadequate and he had had no opportunity of examining the types. One of these was *Comatula japonica*.

Later Carpenter visited the Leyden Museum and there studied the type of *Alecto japonica*, publishing a redescription of it, under the name of *Actinometra japonica*, in 1881. He said that it is a very well defined species, the axillaries being longer and having sharper distal angles than those of any other comasterids he had seen. He noted that the great length of the lower pinnules is also remarkable.

In another paper published in 1881 Carpenter mentioned that an *Actinometra*, not further identified, which had been brought from Yeddo by Prof. Edward S. Morse, had yielded a myzostome.

In 1882 Prof. F. Jeffrey Bell published a specific formula for this species, and early in 1883 Carpenter published an emended formula.

In 1884 Prof. Ludwig von Graff published an account of the myzostomes from Professor Morse's specimens from Yeddo, which he cited under the name of *Actinometra morsei*, this name having been furnished him by Carpenter. He also described the myzostomes from a specimen of *Actinometra japonica*.

In the *Challenger* report on the comatulids published in 1888 Carpenter inserted *Actinometra japonica* in the key to the species of the *Parvicirra* group. The diagnostic characters as given are the presence of IIBr 4 (3+4) series, and sometimes of IIIBr 4 (3+4) series, cirri XXX+, 15–20, the lower pinnules not especially large, the brachials of moderate length, and the lower segments of P_D rather large and carinate. This species is twice inserted in the key, both times paired with *Actinometra trichoptera* in which, according to Carpenter, the brachials are short and the lower segments of P_D are not carinate.

Carpenter mentioned that there is a considerable resemblance between *trichoptera* and *japonica*, and that he would now refer to the latter, possibly as a varietal form, the individual which he had called *Actinometra morsei* when asked by von Graff to name the host of *Myzostoma nigrescens*.

In 1895 Dr. Jiuta Hara mentioned that this species is very common along the coast line near Misaki.

In 1908 I recorded, as *Comaster japonica*, a number of specimens from Tokyo Gulf and Sagami Bay which had been dredged by Mr. Alan Owston in the *Golden Hind*.

In 1911 I published notes on the type specimen in the Leyden Museum, which I had examined in 1910.

In 1912 Dr. Clemens Hartlaub recorded and gave notes upon 2 of Professor Morse's specimens from Yeddo Bay. He called one of these *Actinometra trichoptera* and the other *Actinometra japonica* var. *morsei*. I believe that his new species *Actinometra spinipinna* which was described at the same time is another of Professor Morse's specimens from Tokyo (Yeddo) Bay.

In 1913 I recorded a specimen of *japonica* from off Hong Kong Harbor; this should, however, have been referred to *pinguis*.

In 1924 Dr. Torsten Gilsén discussed a number of the structural features of this species, his material consisting of 6 specimens which had been dredged by Dr. Th. Mortensen in southern Japan in 1914. These he recorded and described in detail in 1927.

COMANTHUS SOLASTER (A. H. Clark)

Plate 20, Figure 51

[See also vol. 1, pt. 1, fig. 81 (dorsal view), p. 134]

Comatula solaster A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 153 (description; *Albatross* Sta. 4944).

Comaster solaster A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed); vol. 34, 1908, p. 317 (Japan).

Phanogenia solaster A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus solaster A. H. Clark, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed); Crinoids of the Indian Ocean, 1912, p. 94 (synonymy; range); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 49 (in key; range).

Comanthus (*Comanthus*) *solaster* A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 147 (Formosa Channel, 35 fathoms).

Comanthus (*Bennettia*) *solaster* A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (southern Japanese species; range and its significance).

Diagnostic features.—With its very broad and dorsally flattened division series which are in close lateral contact, and its numerous undeveloped cirri, this species has more the appearance of a species of *Comanthina* than that of any of the other forms in the genus *Comanthus*.

The longest cirri have 18–30 (rarely more than 25 and usually about 20) segments, and the arms, which are short, stout, broad at the base and rapidly tapering, are 15–36 (usually about 20) in number, and from 80 to 90 mm. in length.

Description.—The centrodorsal is large, discoidal, with the bare polar area flat, 6 mm. in diameter. The cirrus sockets are arranged in a single marginal row.

The cirri are XV–XXV (usually about XX), 18–23 (rarely as many as 30), 20 mm. long, resembling those of *C. japonica* but slightly less stout.

The radials and most or all of the IBr_1 are concealed by the centrodorsal. The IBr_2 (axillaries) are triangular, twice as broad as long or even broader. The IIBr series are 4 (3+4). The IIIBr series are 4 (3+4), but are not developed in the entire series. The division series are more or less flattened dorsally and are broad and in close lateral apposition, being separated only very slightly by the dorsal carination of P_D.

The arms are 15–30 in number, from 80 to 90 mm. long, comparatively stout, especially in the basal portion. The first 2 brachials are rather large, subequal, slightly wedge-shaped, about twice as broad as long exteriorly. The first syzygial pair (composed of brachials 3+4) is oblong, from half again to twice as broad as long. The next 3 brachials are oblong, two and one-half times as broad as long, and those following become triangular, half again as broad as long, and short wedge-shaped in the distal half of the arm. From about the fourth onward the brachials have rather prominent distal edges.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 20+21, and distally at intervals of 4 or 5 (usually 4) muscular articulations.

The disk is 20 mm. in diameter, and bears a few scattered calcareous granules in the anal area. The mouth is marginal, radial, or interradial. The anal tube is very large and centrally situated.

P_D is 25 mm. long, moderately stout basally but becoming slender after the proximal third. The terminal comb has 10–13 small and rounded, well separated teeth. P_P and P_1 are similar, only slightly if at all shorter than P_D, and only slightly less stout basally. P_2 is much more slender, 12 mm. long. P_3 is small and weak, about 7 mm. long. P_4 and the following pinnules are somewhat stouter, with long gonads, 10 mm. long. The distal pinnules are slender, 12 or 13 mm. long. The segments in the proximal third or half of the pinnules are produced into a spinous carination, this feature gradually disappearing on the distal pinnules.

The color in alcohol is dark purple with the disk, cirri, and pinnules brownish yellow and the arms with a lighter median line, or yellow or brown.

Remarks.—Notwithstanding the highly characteristic appearance of typically developed individuals, intergrades occasionally are found between this species and both *C. pinguis* and *C. japonica.* It can not be confused with any other species of *Comanthus,* but a specimen without locality might possibly at first be mistaken for *Comanthina schlegelii.*

Notes.—The specimens from Mortensen's station 10 show the following characters.

The centrodorsal is pentagonal, 5.5 mm. in diameter. The free dorsal pole is 4 mm. across.

The cirri are XXIX, 19–21, from 15 to 20 mm. in length. The fifth-seventh segments are the longest, from one-half to three-quarters again as long as broad. From the tenth onward dorsal processes are developed.

The 21 arms are 70 mm. long. The 10 IIBr series and the single IIIBr series are 4 (3+4). The width of the $IIBr_1$ is 2.8 mm. The interspace between the IIBr series is 0.4 mm. broad. The division series are very high and arched dorsally, and are in close lateral contact. The IBr_1 is ten times as broad as long, and the IBr_2 (axillary) is three times as broad as long.

The intersyzygial interval is 4 muscular articulations.

P_D has a comb consisting of 12 teeth. The pinnules following as far as P_4 bear combs. The distal pinnules are from 6.5 to 7 mm. long. The 5 basal segments of each pinnule have spiny tubercles directed aborally.

The disk is 18 mm. in diameter. The color is yellow brown.

The centrodorsal is rounded, 6.5 mm. in diameter, with the free dorsal pole 5.5 mm. in diameter.

The cirri are XXVIII, 20–21, from 15 to 17 mm. long.

The 20 arms are 60+ mm. long. The IBr_1 are concealed by the centrodorsal. The IBr_2 (axillaries) are four times as broad as long. The width of the $IIBr_1$ is 3 mm. The division series are very closely appressed and laterally flattened against each other.

P_D has a comb consisting of about 10 teeth, which are short and inconspicuous; the terminal segments are without teeth. It is 17 mm. in length. P_4 is 6.5 mm. in length and bears a comb. The distal pinnules are from 9 to 9.5 mm. long.

The disk is 17 mm. in diameter. The anal area is granulated. The anal tube is wart-shaped, 5 mm. broad and 3 mm. high.

The color is olive brown.

The specimens from Mortensen's station 13 exhibit the following features:

The cirri are XXV, 19, from 12 to 17 mm. long. The 19 arms are from 50 to 70 mm. in length. The pinnules as far as P_3 bear combs of 8–12 teeth. The disk is 14 mm. in diameter.

The 18 arms are from 60 to 90 mm. long.

The 18 arms are from 50 to 60 mm. in length, and the disk is 14 mm. in diameter.

The 20 arms are from 50 to 60 mm. long, and the disk is 12 mm. in diameter.

The 20 arms are from 50 to 60 mm. in length, and the disk is 16 mm. in diameter.

The cirri are XXX, 20–21, from 16 to 19 mm. in length. The 25 arms are 70 mm. long. The disk is 19 mm. in diameter. Gislén says that this specimen is of the dark-color type.

The arms are 19 in number, all broken. The disk is 13 mm. in diameter.

The cirri are XXIV, 14–16, from 8 to 11 mm. long. The diameter of the centrodorsal is 2.2 mm. The 14 arms are from 35 to 55 mm. long. The division series are to the left in 3 cases, and to the right in 1 case. The pinnules as far as P_3 bear combs. The disk is 8 mm. in diameter. The anal tube is central.

The centrodorsal is 2.2 mm. in diameter. The cirri are from 8 to 13 mm. long. The 17 arms are all broken. The disk is 9 mm. in diameter.

The specimen from Tokyo Bay has 36 arms about 70 mm. in length. The centrodorsal is thin discoidal, with the dorsal pole 6 mm. in diameter. The cirri are numerous, about XXXV, 18–20, about 12 mm. long, and slender. The division series are very broad, almost or quite in lateral contact.

Remarks.—In the typical form of this species the division series are very massive, forming a compact cup, so that none of the perisome is visible from the dorsal side. Indeed, the division series are sometimes so very closely joined that it becomes difficult to trace the sutures between them.

Very small specimens show that this character is assumed at an early period of growth.

Localities.—Formosa Channel; 64 meters; Captain Suensson, November 23, 1901 [A. H. Clark, 1909, 1912, 1913, 1918] (1, C. M.).

Northeast of Swatow, China (lat. 23° 15′ N., long. 117° 40′ E.); Capt. H. Christiansen, July 26, 1912 (4).

Albatross station 4894; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 41° E., 5 miles distant (lat. 32° 33′ 00″ N., long. 128° 32′ 10″ E.); 174 meters; green sand, broken shells, and pebbles; August 9, 1906 (9, U.S.N.M., 35074, 35154, 35155).

Albatross station 4893; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 29° E., 5.5 miles distant (lat. 32° 32′ 00″ N., long. 128° 32′ 50″ E.); 174–194 meters; bottom temperature 13.28° C.; gray sand, broken shells, and pebbles; August 9, 1906 (4, U.S.N.M., 34997).

Mortensen's station 10; off the Goto Islands (lat. 33° 41′ N., long. 128° 50′ E.); 137 meters; sand; May 17, 1914 [Gislén, 1927].

Mortensen's station 13; southwestern Japan, off Kiu Shiu (lat. 34° 20′ N., long. 130° 10′ E.); 110 meters; sand and shells; May 18, 1914 [Gislén, 1927].

Albatross station 4880; Korean Straits, near the Oki Islands; Oki Shima bearing S. 79° W., 7.5 miles distant (lat. 34° 16′ 00″ N., long. 130° 16′ 00″ E.); 108 meters; bottom temperature about 16.72° C.; fine gray sand and broken shells; August 2, 1906 (1, U.S.N.M., 35152).

Albatross station 4895; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki light bearing N. 42° E., 4.7 miles distant (lat. 32° 33′ 10″ N., long. 128° 32′ 10″ E.); 174 meters; green sand, broken shells, and pebbles; August 9, 1906 (6, U.S.N.M., 35064).

Albatross station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki light bearing N. 58° E., 4.5 miles distant (lat. 30° 57′ 20″ N., long. 130° 35′ 10″ E.); 188 meters; bottom temperature 15.89° C.; stones; August 16, 1906 (1, U.S.N.M., 35153).

Albatross station 4944; off Kagoshima Gulf; Yebisu Jima bearing W. 2.8 miles distant (lat. 31° 38′ 15″ N., long. 130° 46′ 50″ E.); 79 meters; bottom temperature 18.00° C.; black sand and lava pebbles; August 17, 1906 [A. H. Clark, 1908, 1912, 1913, 1918] (1, U.S.N.M., 22656). Pl. 20, fig. 51.

Kagoshima Bay; U. S. Exploring Expedition (1, U.S.N.M., 35158 [part of 3033]).

Albatross; Misaki, Sagami Bay; shore; 1906 (1, U.S.N.M., 35145).

Misaki (2, U.S.N.M., 39153).

Albatross station 5070; in Suruga Gulf; Ose Saki bearing S. 8° W., 1.8 miles distant (lat. 35° 03′ 25″ N., long. 138° 47′ 40″ E.); 197 meters; bottom temperature 14.22° C.; mud, sand, and broken shells; October 15, 1906 (1, U.S.N.M., 35101).

Tokyo Bay (1, M. C. Z., 30).

Japan; H. Loomis (1, U.S.N.M., 36167).

Geographical range.—From the Formosa Channel to the Korean Straits, and eastward to Tokyo Bay.

Bathymetrical range.—From the shore line down to 197 meters. The average of 11 records is 128 meters.

Thermal range.—From 13.28° C. to 18.00° C. The average of 5 records is 15.62° C.

History.—This species was originally described in 1908 from a single specimen from *Albatross* station 4944. Another specimen from the Formosa Channel was recorded in 1909. In 1927 Dr. Torsten Gislén recorded and published notes upon 11 specimens which had been secured by Dr. Th. Mortensen in southern Japan in 1914.

COMANTHUS TRICHOPTERA (J. Müller)

Plate 3, Figure 4; Plate 74, Figure 203

[See also vol. 1, pt. 1, fig. 50 (pinnule tip), p. 81; fig. 60 (comb), p. 85; fig. 330 (cirrus), p. 281; part 2, fig. 120 (division series), p. 79; figs. 525, 526 (arm tip), p. 283; figs. 646–648 (comb), p. 327; pl. 10, fig. 1024 (analysis of arm structure); pl. 12, fig. 1036 (brachials); pl. 14, fig. 1065 (part of arm); pl. 17, fig. 1078 (oral pinnule)].

Comatula trichoptera (Valenciennes, MS.) J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1846, p. 178 (description; King George's Sound, Australia); Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 257 (redescribed).—Dujardin and Hupé, Hist. nat. des zoophytes, Echinodermes 1862, p. 205 (synonymy; description; Australia).—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 441; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 26 (reason for lack of precision in Müller's definition).—A. H. CLARK, Bull. du mus. d'hist. nat., Paris, 1911 No. 4, p. 245 (identity); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 436 (history); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 712 (history); Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Actinometra trichoptera P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2. vol. 2, 1879, p. 27 (systematic position); Proc. Roy. Soc., vol. 28, 1879, p. 386.—BELL, Proc. Zool. Soc. London, 1882, p. 534 (listed); p. 535 (specific formula).—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, pp. 740 and following (discussion of Bell's method of formulation, and corrected formula).—BELL, Ann. and Mag. Nat. Hist., ser. 6, vol. 2, 1888, p. 404 (very abundant at Port Phillip).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 345 (description; Port Jackson, 10–12 fathoms; other localities); pl. 63, figs. 1–5.—WHITELEGGE, Journ. Roy. Soc. New South Wales, vol. 23, 1889, p. 198 (Watson's Bay; habitat).—P. H. CARPENTER, Proc. Roy. Soc. Victoria, new ser., vol. 2, 1890, p. 135 (Port Phillip).—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 716 (identity of the *Challenger* record; credited to Australia by P. H. Carpenter); Crinoids of the Indian Ocean, 1912, p. 36 (identity of Carpenter's record).—HARTLAUB, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 281, 414 (listed); p. 477 (localities, except Yeddo).

Comaster trichoptera A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia trichoptera A. H. CLARK, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus trichoptera A. H. CLARK, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 363 (south Australian species belonging to a tropical genus); p. 366 (listed); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 13 (closely related to *C. wahlbergii*); p. 17 (nearest species to *C. wahlbergii*); p. 18 (comparison with *C. wahlbergii*); Notes from the Leyden Mus., vol. 33, 1911, p. 181 (axillaries compared with those of *japonica*); American Journ. Sci., ser 4, vol. 32, 1911, p. 130 (significance of distinctive characters); Bull. du mus. d'hist. nat., 1911, No. 4, p. 245 (identity); p. 249 (locality; description of the type); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 441 (south Australian species occurring north to Bunbury and Broughton I.); p. 443 (range on east coast); p. 444 (range on west coast); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 715 (recorded by Bell from Port Phillip); p. 717 (known to P. H. Carpenter from Australia); p. 718 (original notes by Whitelegge; notes by P. H. Carpenter, 1890); p. 722 (confined to south Australia); p. 733 (in key); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 391 (southwest Australia); Crinoids of the Indian Ocean, 1912, p. 9 (confined to south Australia); p. 30 (= *Comatula trichoptera* J. Müller, 1849); p. 36 (= *Actinometra trichoptera* P. H. Carpenter, 1888); p. 95 (south coast of Australia and Tasmania, 0–12 fathoms); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 15 (published references to the specimens in the British Museum; localities represented; characters of the specimens); Die Crinoiden der Antarktis, 1915, p. 167 (range); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 226 and following (detailed account of the distribution in Australia).—H. L. CLARK, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, p. 5 (characteristic of the south Australian subregion); p. 17 (comparison with *C. plectrophorum*).—HARTMEYER, Mitt. zool. Mus. Berlin, vol. 8, Heft. 2, 1916, p. 234 (southwest Australia, No. 5960).—A. H. CLARK, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 43 (uncertainty of the status of related forms); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 49 (in key; range).

Comanthus (*Comanthus*) *trichoptera* A. H. CLARK, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 30 (comparison with *C.* [*C.*] *samoana*).

Comanthus (*Bennettia*) *trichoptera* A. H. CLARK, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 456 (Koombana Bay, 14½–18 m.; other localities; descriptions of specimens); p. 465 (association with other species); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 755 (annotated synonymy; characters; localities; distribution; good species for the study of embryology); Crinoids of the Indian Ocean, 1912, p. 13 (related to *C.* [*B.*] *wahlbergii*).

Comanthus (*Cenolia*) *trichoptera* A. H. CLARK, Proc. Biol. Soc. Washington, vol. 29, 1916, p. 48 (characteristic of and confined to southeastern Australia and Tasmania).

Diagnostic features.—The broad discoidal centrodorsal with a flat dorsal pole bearing numerous rather slender cirri with usually 18–20 segments of which the longest are twice as long as broad, from 10 to 14 mm. (usually about 12 mm.) in length, the 15–28 (usually about 20) rather short and rapidly tapering arms which are from 60 to 130 mm. (but rarely over 100 mm.) long, and the curiously pointed axillaries make this species an easy one to recognize. Aside from its immediate relatives in Tasmania and New Zealand, it resembles most closely the much smaller South African *C. wahlbergii*.

Description.—The centrodorsal is discoidal, broad, the polar area 4 mm. in diameter and flat. The cirrus sockets are arranged in one and a more or less complete second crowded marginal row.

The cirri are XXV–XXXVII, 13–20 (usually 17–18), 12 mm. long, and remarkably slender. The first 2 segments are short, twice as broad as long, the third is half again as long as broad, and the next 3 or 4 segments are twice as long as broad. The following segments decrease rapidly in length so that the outermost 7 or 8 are from half again to twice as broad as long. The third and following segments have somewhat expanded articulations, this character decreasing as the segments become shorter. In the proximal portion the cirri are well rounded in cross section, but they become laterally flattened on the short distal segments, here appearing somewhat broader in lateral view. The seventh is a more or less marked transition segment; this and the following have the distal dorsal edge slightly thickened, this thickening soon becoming transformed into a small subterminal tubercle. The opposing spine is minute, with the apex subterminal. The terminal claw is somewhat longer than the penultimate segment, and is stout and strongly curved.

The radials are concealed, except in the interradial angles of the calyx. The IBr_1 are very short and are partially united laterally. The IBr_2 (axillaries) are triangular, with the anterior angle unusually produced and sharp, and are free laterally. The IIBr series are 4 (3+4), usually more or less deficient. The IIIBr series are 4 (3+4), but are few in number or absent altogether. The first ossicles after each axillary are united for about their proximal three-fourths, but from that point onward, and exteriorly, the division series and arms are well separated.

The arms are 15–28 in number, from 60 to 100 mm. in length. The first 2 brachials are subequal, wedge-shaped, about two and one-half times as broad as long exteriorly, the second in apposition interiorly. The first syzygial pair (composed of brachials 3+4) is oblong, two or two and one-half times as broad as long. The next brachial is oblong or slightly wedge-shaped, twice as broad as long. The following brachials are triangular, about twice as broad as long, after the proximal third of the arm becoming somewhat shorter and more or less wedge-shaped, and terminally somewhat longer. From the eighth or tenth onward the brachials develop rather strongly overlapping distal ends.

Syzygies occur between brachials 3+4, again from between brachials 10+11 to between brachials 14+15, and distally at intervals of usually 4 muscular articulations.

The disk is from 9 to 12 mm. in diameter and naked; the mouth is interradial and marginal.

P_D is from 9 to 16 mm. in length and is composed of 30–35 segments, which become about as long as broad on the fifteenth or seventeenth. The lower segments have the distal outer edge rather strongly produced and spinous, this feature gradually dying away as the segments become longer. The terminal comb is composed of about 9 teeth which are rather small and well rounded and are repeated, usually slightly smaller, on the opposite side of the pinnule. P_1 is slightly less stout basally than P_D and slightly shorter. P_2 is about 5 mm. long, small, and weak. P_3 and the following pinnules are 6 or 7 mm. long, stouter and tapering much less rapidly than P_2, composed of 20–23 segments, of which the third-seventh or -eighth bear a very strong spiny carinate process, diminishing in height distally. The distal pinnules are of about the same length, but slender. The terminal comb is not present after P_2. The strong carination of the proximal pinnule segments, which is one of the most marked characters of the species, persists even in the terminal pinnules, though in a somewhat reduced form.

The color in alcohol is light yellowish brown, mottled with gray or darker brown; or brown, the arms with a median line of darker.

Notes.—One of the specimens from Broughton Island has 20 arms 90 mm. long, and the cirri XXVI, 19–21, 12 mm. long. Two of the others are similar, with 24 and 28 arms. Another is small, with 16 arms 35 mm. long, and the last is also small.

One of the specimens from Watsons Bay has 22 arms 110 mm. long, and the cirri XIX, 18–20, 12 mm. long. Another has 31 arms, and the cirri XLVI, 14 mm. long. A third has 28 arms and the cirri XLII.

In the 2 specimens from Bottle and Glass Rocks the centrodorsal is very small.

One of the specimens from Port Jackson is typical, with 20 arms 100 mm. long, and the cirri XXXII, from 10 to 14 mm. in length. Three of the specimens are peculiar in having the centrodorsal very small, with the dorsal pole only 2 mm. in diameter, though bearing the usual number of cirri.

Having at hand a specimen from Port Jackson and a number from Port Phillip, Carpenter said that the centrodorsal is a relatively broad disk.

The cirri are XXX or more, 16. A few of the segments are longer than broad, and the penultimate has but little trace of an opposing spine.

The radials are scarcely visible. The IBr_1 are but partially united laterally. The IIBr series are 4 (3+4). The IVBr series, if present, are 4 (3+4). The division series are quite free laterally, and the distal angles of the axillaries are rather sharp.

The 15–22 arms are 60 mm. long. The brachials are slightly overlapping, the proximal being relatively short and triangular and the distal gradually becoming longer and more quadrate.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 13+14, and distally at intervals of 4 or 5 muscular articulations.

P_D is about 9 mm. long, and P_1 is but little shorter. The next 2 or 3 pinnules diminish rapidly in length, but become swollen for the gonads and lose the terminal comb. The lower segments of the earlier pinnules sometimes overlap rather sharply and have spinose edges.

The disk is 9 mm. in diameter and is naked. The mouth is interradial.

The color in alcohol is light yellowish brown mottled with gray or darkish brown.

A specimen from Port Jackson in the Museum of Comparative Zoölogy has 21 arms about 100 mm. in length.

The 4 specimens in the Museum of Comparative Zoölogy from Port Jackson show the following characters. In one the centrodorsal is small, with the cirri XXXVII, 13–16. The 21 arms are 60 mm. long, with the brachials short triangular and strongly overlapping. All the division series are 4 (3+4). The distal pinnule segments have strong recurved hooklike spines. This individual is sexually mature and carries eggs. In a second specimen the cirri are about XXX, 20, and are arranged in 2 irregular rows on the centrodorsal; as in the preceding the distal cirrus segments bear small dorsal spines. The 22 arms are 65 mm. long, with short triangular and strongly overlapping brachials. As in the preceding, P_D is slender and not carinate. The pinnules bear eggs. The third specimen resembles the other 2 and is the size of the first. There are 15–17 cirrus segments and 22 arms. The pinnules bear eggs. The fourth specimen resembles the other 3, but bears no eggs. There are 17 cirrus segments and 20 arms 80 mm. long. In all the specimens the IBr_2 and the IIBr series are separated. The color is yellowish brown.

The 8 specimens collected by Dr. Th. Mortensen at Port Jackson present the following characters: One has 30 arms 80 mm. long. All 10 IIBr series and 10 IIIBr series are present, and all are 4 (3+4). The centrodorsal is 3.5 mm. in diameter and has a rather broad depressed center with shallow grooves radiating out to between the cirrus bases. The cirri are XXXIV, 15–17, 9 mm. long. One has 22 arms, of which the anterior are 115 mm. long. All the IIBr series are present, and there are 2 IIIBr series, both external. All the division series are 4 (3+4). The centrodorsal is 4 mm. in diameter, with a narrow raised rim, a depressed central area 1 mm. in diameter, and a narrow raised line radiating from the central pit to the base of each cirrus. The cirri are about XLV, 17–18, 13 mm. long, with the distal portion strongly recurved. The division series and arm bases have a narrow faint dark median line. One specimen has 24 arms 110 mm. long; all the IIBr series and 4 IIIBr series are present, and all the division series are 4 (3+4). The cirri are XXV, 16–18. The disk is 20 mm. in diameter. Another specimen has 24 arms 110 mm. long, with 10 IIBr series and 4 IIIBr series, all 4 (3+4). The cirri have 16–17 segments. One specimen has 27 arms 110 mm. long. There are 17–19 cirrus segments. A specimen with 23 arms has all the division series 4 (3+4) and the cirri XL, 16–17. A specimen with 22 arms has 10 IIBr series and 2 IIIBr series, all 4 (3+4). A specimen with 20 arms has 10 IIBr 4 (3+4) series.

The type specimen from King Georges Sound is small, but quite typical of the species as now understood. As described by Müller, it has 20 arms. The centrodorsal is relatively large, with the broad dorsal pole slightly concave. The cirri are arranged in a single marginal row. The cirri are XXX, 15; they are remarkable for their slenderness and for the form of the segments, which are much compressed laterally and of which only the last bears a tubercle. The first pinnules are large.

The larger of the 2 specimens from Koombana Bay has 20 arms 70 mm. long. The dorsal pole of the centrodorsal is flat, 3.5 mm. in diameter. The cirri are XXV, 16–19 (usually nearer the latter), from 11 to 13 mm. long. The smaller specimen has also 20 arms.

A specimen without locality in the Australian Museum is an usually fine example, with 25 arms 130 mm. long.

Remarks.—This species is very closely related to *C. tasmaniae* from Tasmania and to *C. benhami* and *C. novaezealandiae* from New Zealand. It is somewhat less closely related to the South African *C. wahlbergii*, and still more distantly to *C. japonica*, *C. pinguis*, and *C. solaster* of southern Japan. The curiously pointed axillaries so characteristic of *C. trichoptera* are also seen in *C. japonica* and *C. pinguis*, and sometimes also in *C. solaster*. It is not closely related to any of the other species of the subgenus *Cenolia*.

Localities.—Cape Hawke, New South Wales; 46–51 meters [A. H. Clark, 1911] (2, U.S.N.M., 36151; Austr. M.).

Broughton Island, near Port Stephens, New South Wales (about lat. 32° 40′ S.) [A. H. Clark, 1911] (5, U.S.N.M., 35060; Austr. M.).

Watsons Bay, Port Jackson, New South Wales [A. H. Clark, 1911] (5, U.S.N.M., 34967; Austr. M.).

Bottle and Glass Rocks, Port Jackson [A. H. Clark, 1911] (2 U.S.N.M., 35069; Austr. M.).

Challenger; Port Jackson; 18–22 meters [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.).

Port Jackson [Whitelegge, 1889]. Same [A. H. Clark, 1911] (9 U.S.N.M., 17877, 35059, 35066; Austr. M.). Same (4, M. C. Z., 38, 211). Pl. 3, fig. 4.

Port Jackson; shallow water, under stones; Dr. Th. Mortensen, February 27, 1915 (8). Pl. 74, fig. 203.

Bass Strait, between Australia and Tasmania; about 73 meters; 1915 (1 M. C. Z., 727).

Western Port (just east of Port Phillip), Victoria (3, M. C. Z., 504, 505).

Port Phillip, Victoria; J. Bracebridge Wilson [Bell, 1888; A. H. Clark, 1911, 1913] (2, B. M.).

Port Phillip; outer stations of the Port Phillip Biological Survey, and outside the Heads; J. Bracebridge Wilson [P. H. Carpenter, 1888, 1890].

King Georges Sound (or Port), Western Australia; MM. Quoy and Gaimard, 1829 [J. Müller, 1846, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1877, 1879, 1883, 1888; Bell, 1882; A. H. Clark, 1911, 1912, 1918] (1, P. M.).

Hamburg southwest Australia expedition station 56; Koombana Bay, 6–7 miles southwest of Bunbury, Western Australia; 14.5–18 meters; bottom rocky, with a few plantlike organisms; July 28, 1905 [A. H. Clark, 1911, 1912; Hartmeyer, 1916] (2, Berl. M., 5960).

Australia [A. H. Clark, 1911] (1, U.S.N.M., 35016).

No locality [A. H. Clark, 1911, 1913] (2. B. M.).

Geographical range.—Southern coasts of Australia northward to Cape Hawke, New South Wales, and Bunbury, Western Australia.

Bathymetrical range.—From the shore line down to 73 meters. The average of 4 records is 34 meters.

Occurrence.—Whitelegge says that this species is common under stones at low water at Watsons Bay, Port Jackson.

Remarks.—Bell wrote that this is obviously a very abundant species at Port Phillip. He said that he looked forward with interest to the arrival of fully grown individuals, as he suspected, from what he had seen of the smaller specimens that had reached him, that the cirri would exhibit an interesting dimorphism.

History.—This species was originally described by Johannes Müller in 1846 from a small specimen from King Georges Port (now Albany), Western Australia, which had been collected in 1829 by Quoy and Gaimard and deposited in the Paris Museum. Müller found it bearing the manuscript name *Comatula trichoptera* given it by Valenciennes, and under this name he described it. Müller redescribed the species in 1849, and in 1862 Dujardin and Hupé published a translation of his description without comment.

In 1879 Dr. P. H. Carpenter, after an examination of the 2 specimens in the Paris Museum, assigned *trichoptera* to *Actinometra* and remarked that, as the disk of the types can be readily examined, he believed Müller did not allocate the species more precisely for the reason that he was unable to decide whether it should be referred to *Alecto* or to *Actinometra*, for in 1 of the 2 specimens at Paris 5 groove trunks start from the excentric peristome, while in the other there are only 4.

In another contribution published in 1879 Carpenter listed this species as having been secured by the *Challenger*.

In 1882 Prof. F. Jeffrey Bell published a specific formula for this form, and early in the following year Carpenter published a revised formula.

In the *Challenger* report upon the comatulids, published in 1888, Carpenter redescribed this species on the basis of a single specimen secured by the *Challenger* at Port Jackson and others from Port Phillip.

In 1888 Prof. F. Jeffrey Bell recorded specimens of this species which had from time to time been sent to the British Museum from Port Phillip, Victoria, by Mr. J. Bracebridge Wilson, and in 1889 Mr. Thomas Whitelegge recorded it from Watsons Bay, near Sydney, New South Wales, and gave notes on the manner of its occurrence there.

Dr. P. H. Carpenter in 1890 recorded specimens from Port Phillip which he had identified for the Port Phillip Biological Survey Committee. They had been dredged by Mr. J. Bracebridge Wilson in the outer harbor at Port Phillip and outside the Heads in the summer of 1887–88. The specimens referred to in this paper furnished the basis for the insertion of "Port Philip" among the localities given in the *Challenger* report.

In 1911 I mentioned having examined one of the specimens collected at King Georges Port (or Sound) by Quoy and Gaimard in 1829. In a memoir on the crinoids of Western Australia published in 1911 I recorded specimens from Koombana Bay, and gave a summary of its occurrence on the Western Australian coasts. In a monograph on the crinoids of Australia, which was also published in 1911, I recorded numerous specimens from various localities in southeastern Australia, and gave a general account of the species. In a memoir on the crinoids of Africa published in the same year I pointed out the close relationship between this species and the South African *C. wahlbergii*.

In 1912 Dr. Clemens Hartlaub recorded and described a specimen supposedly of *trichoptera* from Yeddo (Tokyo) Bay, Japan. In reality it represents *C. japonica*.

At the same time he described as a new species *Actinometra spinipinna* which he said is near *trichoptera.* This new species, the type specimen of which bore no locality label, is also *C. japonica.*

In 1913 I published notes upon the specimens of this species contained in the collection of the British Museum, and in two papers which appeared in 1915 I discussed its range in detail.

COMANTHUS TASMANIAE A. H. Clark

Comanthus trichoptera (part) A. H. Clark, Die Fauna südwest-Australiens, vol. 3, Lief. 13, 1911, p. 456 (Tasmania, but not the other localities); Crinoids of the Indian Ocean, 1912, p. 95 (Tasmania); Die Crinoiden der Antarktis, 1915, p. 167 (Tasmania); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, pp. 226 and following (Tasmania).—H. L. Clark, Biol. Results Fishing Exper. F. I. S. *Endeavour*, 1909–1914, vol. 4, pt. 1, 1916, pp. 5, 17.—A. H. Clark, Unstalked crinoids of the *Siboga* Exped., 1918, p. 49 (in key; Tasmania).

Comanthus (*Bennettia*) *trichoptera* (part) A. H. Clark, Mem. Australian Mus., vol. 4, pt. 15, 1911, p. 755 (Tasmania).

Comanthus tasmaniae A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41 (listed from Tasmania; synonymy [*Comanthus spanoschistum* erroneously included]); p. 42 (detailed description; Tasmania; probably the same as the multibrachiate specimens of *Comanthus spanoschistum* [error]); p. 43 (compared with C. *novaezealandiae*).

Diagnostic features.—This species is very closely related to *C. trichoptera*, but the cirri have 14–16 segments, of which the longest are two and one-half times as long as broad. There are about 40 (37) arms which are 65 mm. in length.

Description.—The centrodorsal is discoidal, rounded pentagonal in outline, extremely thin, 4 mm. in diameter. The cirri are arranged in a single incomplete and more or less irregular marginal row.

The cirri are XX, 14–16, slender, 10 mm. long. The first segment is broader than long, the second is as long as, or slightly longer than, broad, the third is twice as long as broad, the 3 following are about two and one-half times as long as broad, and their successors rapidly become shorter, so that the terminal 8 are broader than long. These last are somewhat compressed laterally and in lateral view appear slightly broader than those preceding. With the 1 or 2 preceding they each bear a small pointed subterminal tubercle.

The arms in the type specimen are 37 in number and resemble those of *C. trichoptera.* The distal edges of the elements of the division series and the of brachials, especially the latter, are strongly everted and finely spinous.

Locality.—Tasmania [A. H. Clark, 1911, 1918] (2, U.S.N.M., 34976; Austr. M.).

Remarks.—In 1911 I recorded under the name *Comanthus trichoptera* 2 specimens from Tasmania which were not quite typical of the species as represented on the coast of southern Australia.

Later, after the description of *Comanthus benhami* in 1916 and the receipt of a second new form (*novaezealandiae*) from New Zealand, I decided that the peculiarities of these 2 Tasmanian specimens warranted their recognition as representatives of a new species.

One of them had been returned to the Australian Museum, so the description of *Comanthus tasmaniae* was based upon the single specimen which had been retained by the National Museum.

In 1916 Dr. H. L. Clark had described a species from Bass Strait under the name *Comanthus spanoschistum*, of which most of the individuals examined by him had 10 arms, but three had 13, 14, and 19, respectively.

From his published account I assumed that the 10-armed individuals represented a species of *Comissia* and those with more than 10 arms a species of *Comanthus*. So in the original description of *Comanthus tasmaniae* I said that my new form probably included the multibrachiate examples of *C. spanoschistum* listed by Dr. H. L. Clark from Bass Strait and Tasmania. Doctor Clark's 10-armed specimens I listed as *Comissia spanoschistum*.

Had my supposition that the 10-armed and multibrachiate specimens of *Comanthus spanoschistum* represent different species been correct, the name *spanoschistum* should have been retained for the form represented by the multibrachiate specimens, since Doctor Clark's figure of the holotype is a photograph of an individual with 13 or more arms from east of Flinders Island, Bass Strait, in 100–300 fathoms (183–548 meters).

Recently I received from Dr. Th. Mortensen a fine series of 24 specimens collected by the *Endeavour* which are undoubtedly Doctor Clark's *Comanthus spanoschistum*. Though quite different in appearance, there can be no doubt that the individuals with 10 and with more than 10 arms really represent the same species, which is quite different from any species of *Comanthus* and from any species of *Comissia*.

COMANTHUS BENHAMI A. H. Clark

Plate 74, figure 202

Comanthus trichoptera benhami A. H. Clark, Proc. Biol. Soc. Washington, vol. 29, 1916, p. 48 (characters; Preservation Inlet).

Comanthus benhami A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41 (listed from New Zealand); p. 43 (compared with *C. novaezealandiae*); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 49 (in key; range).

Diagnostic features.—The cirri are relatively long, with numerous segments, XL–L, 24–27 (usually 26–27), from 22 to 25 mm. in length, and the centrodorsal is large and thick discoidal.

Description.—The centrodorsal is large, thick discoidal, the dorsal pole broad and flat with the center depressed.

The cirri are XL–L, 24–27 (usually 26–27), from 22 to 25 mm. long.

The 28 arms of the type specimen are 115 mm. in length.

Locality.—Preservation Inlet, on the west coast of South (or Middle) Island, New Zealand; 4.6–6 meters; Percy Seymour [A. H. Clark, 1916, 1918] (3, U.S.N.M., 38684; University of Otago, Dunedin, New Zealand). Pl. 74, fig. 202.

Occurrence.—Regarding the associates of this interesting crinoid, which was the first ever to be found in New Zealand waters, Professor Benham wrote me that from the same locality some hydrocorallines and antipatharians were obtained, and a pennatulid, all of which are "Australian" in their affinities.

The fauna of the west coast of New Zealand is little known, but it differs considerably from that of the east, south, or north coasts of the island. The west coast is difficult to get at and is only sparsely inhabited. Few naturalists have been able to collect there, except very superficially and sporadically, as boats only visit Preservation Inlet very irregularly, and once there one never knows how long one might be compelled to stay, as there is no road across the forest-clad mountains.

History.—This species was described from 3 specimens collected by Mr. Percy Seymour from a rowboat and sent to me by Prof. William B. Benham, of the University of Otago, Dunedin, New Zealand, in 1916. It was originally designated as a subspecies of *Comanthus trichoptera*, but in both the references to it published in 1918 it was given as a full species.

COMANTHUS NOVAEZEALANDIAE A. H. Clark

Comanthus novaezealandiae A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 41 (listed from New Zealand); p. 42 (detailed description; Three Kings I., N. Z., 65 fathoms)

Diagnostic features.—This species differs from *C. tasmaniae,* to which it appears to be most closely related, in having fewer (20) arms, in the lesser length of the elongated earlier cirrus segments, and in the swollen distal borders of the earlier cirrus segments, the distal border of the first 7 cirrus segments in *C. tasmaniae* being quite unmodified.

It is easily distinguished from *C. benhami* by the fewer arms, the much shorter cirri, and the fewer cirrus segments.

Description.—The centrodorsal is discoidal, irregularly circular in outline, broad, flat, and very thin, 5 mm. in diameter. The cirrus sockets are arranged in a single irregular and unequally developed marginal row.

The cirri are XIII+, 17, rather slender, from 10 to 11 mm. in length. The first segment is very short, the second is twice as broad as long, the third is from one-quarter to one-third again as broad as long, the fourth is about half again as long as broad, the fifth is about twice as long as broad, and the sixth is nearly as long. The following segments rapidly decrease in length, so that the last 7 are broader than long; these are somewhat compressed laterally, and therefore broader in lateral view than the preceding. From the fourth onward the distal dorsal border of the segments is thickened, this thickening becoming gradually narrower and more prominent in the central portion, so that on the last 2 or 3 before the penultimate it resolves itself into a low sharp subterminal tubercle. The opposing spine has a transversely broadened chisel-like edge.

There are 20 arms in the specimen described, all of which are broken off at the base. The distal edges of the elements of the division series and of the brachials are very slightly prominent and are bordered with very fine spines.

Locality.—Three Kings Island, New Zealand; 119 meters; hard bottom; Dr. Th. Mortensen, January 5, 1915 [A. H. Clark, 1918] (1).

History.—As yet this interesting species is known only from the type specimen dredged by Dr. Th. Mortensen in 1915 and described in 1918.

COMANTHUS WAHLBERGII (J. Müller)

Plate 65, Figure 183

[See also vol. 1, pt. 1, fig. 161 (dorsal view), p. 223; pt. 2, fig. 700 (disk), p. 341]

Alecto wahlbergii J. Müller, Archiv f. Naturgesch., 1843, vol. 1, p. 131 (description; Port Natal).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 2 (history; a valid species); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 760 (distinct from *parvicirra*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 383 (identity).

Comatula (Actinometra) wahlbergii J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 256 (redescribed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Comatula coccodistoma (part) Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 208 (listed).

Actinometra wahlbergii Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 211 (redescribed).

Comatula wahlbergi von Martens, in Von der Decken's Reise in Ostafrica, vol. 3, 1869, p. 129 (Natal; from Müller).

Actinometra wahlberghii P. H. Carpenter, Proc. Roy. Soc., vol. 28, 1879, p. 386; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (identified as an *Actinometra*).

Actinometra wahlbergi Bell, Proc. Zool. Soc. London, 1882, pp. 534, 535 (listed).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, p. 747 (listed).

Actinometra parvicirra P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 331 (part; Cape of Good Hope); p. 338 (part; Simon's Bay; Cape of Good Hope; Port Natal); p. 340 (discussion).—Bell, Marine Invest. in So. Africa, vol. 4, pt. 4, 1905, p. 141 (various localities).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 5 (South African records are *wahlbergii*).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, April, 1912, p. 475 (Cape of Good Hope; notes).

Antedon capensis (part) Bell, Marine Invest. in So. Africa, vol. 4, pt. 4, 1905, p. 139 (Cape of Good Hope).

Comanthus (Bennettia) wahlbergii A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 17 (synonymy; localities; distinct from *parvicirra*, description).

Comanthus wahlbergii A. H. Clark, Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 249 (Cape of Good Hope); Crinoids of the Indian Ocean, 1912, p. 95 (synonymy; range); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 16 (synonymy; localities; characters); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 49 (in key; range).—H. L. Clark, Annals So. African Mus., vol. 13, pt. 7, 1923, p. 231 (synonymy; Simon's Bay; range); pl. 8, fig. 3.

Actinometra paucicirra (B. M., MS.) A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 16 (Cape of Good Hope).

Comanthus wahlbergi A. H. Clark, Die Crinoiden der Antarktis, 1915, p. 166 (synonymy; Simon's Bay; characters); p. 167.

Comanthus (Cenolia) wahlbergii A. H. Clark, The Danish *Ingolf* Exped., vol. 4, part 5, Crinoidea, 1923, p. 39 (range).

Diagnostic features.—The usually 16–20 arms are short, broad, and rapidly tapering, usually from 60 to 80 mm. in length The cirri, which are relatively stouter than those of *C. trichoptera* and the Tasmanian and New Zealand species and more strongly recurved distally, have usually 15–16 segments and are 10 mm. long.

Description.—The centrodorsal is a thin, rather broad circular disk with the dorsal surface flat or slightly concave and from 2.5 to 4 mm. in diameter. It resembles very closely the centrodorsal of *C. trichoptera.*

The cirri are always numerous and well developed, XII–XXV (usually XIV–XX), 12–17 (usually 15–16), 10 mm. long in fully grown examples. The first segment is very short and those following gradually increase in length, so that the fifth or sixth is twice as long as its proximal width. The next is nearly as long, and those succeeding decrease in length, so that the eighth or ninth and following are as long as broad, or slightly broader than long. The fifth, sixth, or seventh (usually the sixth) is a well-marked transition segment. The transition and following segments have the distal dorsal edge slightly everted, this eversion appearing as a minute subterminal tubercle in lateral view. On the last few segments this eversion of the distal dorsal edge moves basally and becomes a submedian transverse ridge, but it does not narrow into a dorsal spine. The opposing spine is blunt, forked, or represented by a short transverse ridge.

The radials are concealed by the broad centrodorsal. The IIBr series are 4 (3+4). IIIBr series are rarely present. They have only been recorded in 2 individuals, one having 2, both 2, and one having 1, 4 (3+4). The division series are broad, more or less flattened dorsally, and very close together laterally. Their component ossicles have everted and finely spinous distal ends.

The arms are 13–21 (usually 16–20) in number, and in fully grown examples are usually from 60 to 80 mm. in length. They are short, stout, and rapidly tapering. In well-developed specimens they may broaden somewhat from the base to about the twelfth or fourteenth brachial, tapering rapidly from that point onward. The brachials are short, with conspicuously produced and overlapping distal ends.

Notes.—Müller described the original specimens from Durban as follows: The centrodorsal is quite flat, or even concave. The cirri are marginal.

The cirri are XXIV, about 17. The 8 or 9 segments in the distal half bear a small dorsal spine. The basal segments are thicker and broader than long, those following are longer than broad, and the distal are as long as broad.

The radials are concealed, but the IBr series are visible. The IIBr series are 4 (3+4).

The 20 arms are from 67.5 to 80 mm. in length and are composed of short brachials.

The intersyzygial interval is 4–6 muscular articulations.

The first pinnule is larger than the second, and the second is larger than the third. At the base of the arms the distal segments of the pinnules are provided with a high produced keel (the teeth of the terminal comb).

Of these specimens, which Müller studied in the Museum of the Academy of Sciences at Stockholm, 2 were given to the Berlin Museum, and the Berlin Museum subsequently presented 1 of these to the United States National Museum.

In 1 of these 2 last the dorsal pole of the centrodorsal is flat and rather broad, 2.5 mm. in diameter.

The cirri are XIII, 15–16 (usually the latter), 10 mm. long. The first segment is very short, and those following increase in length so that the fifth is twice as long as its proximal width and the sixth is nearly as long. The eighth or ninth and following are slightly broader than long. In all cases the fifth is a transition segment.

The transition and following segments have slightly everted distal dorsal edges which appear as minute sharp subterminal tubercles in lateral view, on the last few segments becoming a submedian transverse ridge, but not resolving into a dorsal spine. The opposing spine is blunt, forked, or represented by a short transverse ridge.

There are 20 arms 45 mm. long. All of the IIBr series are present, and all are 4 (3+4).

The other specimen is similar.

The 20 specimens from off Algoa Bay which I have examined are all young, with from 10 to 12 arms.

One of the specimens from False Bay has 21 arms. There are present 9 IIBr 4 (3+4) series and 2 IIIBr 2 series, 1 external and 1 internal. The cirri are XXV, 15–17; the sixth is a transition segment.

A smaller specimen has 19 arms and the cirri XIV, 13–14.

Of the other 8 specimens, 1 has 13 arms, 1 has 15, 3 have 16, 2 have 17, and 1 has 19.

These 8 specimens from False Bay are all more or less immature. The centrodorsal is broad, flat and circular, just as in *C. trichoptera*. The cirri are VI–XII, 15–16, usually about 7 mm. long. The sixth is a transition segment. The arms are from 30 to 35 mm. in length, and the brachials overlap conspicuously.

Of the specimens from the Cape of Good Hope in the British Museum, 3 have 20 and 1 has 21 arms. In the last the arms are 60 mm. long. The cirri are XII, 15–16, 10 mm. long. The fifth, sixth, or seventh (usually the sixth) is a transition segment. The centrodorsal is thin discoidal, with the broad flat dorsal pole 4 mm. in diameter.

Attached to the cirri of 1 of the 20-armed specimens are the 13 pentacrinoids noticed in volume 1, part 2, page 514.

Hartlaub recorded 3 specimens from the Cape of Good Hope which had been sent to him by the Museum of Comparative Zoölogy. They had 20, 17, and 14 arms. In the last, 2 of the rays are without IIBr series. The IIBr series are all 4 (3+4). There are no IIIBr series. The brachials have only very slightly produced and overlapping distal edges.

The *Challenger* specimen from Simons Bay has 20 arms. It resembles others in the British Museum from the Cape of Good Hope and from False Bay.

Of the 2 *Gauss* specimens from Simons Bay the larger has 15 arms 40 mm. long, each ray bearing a single IIBr 4 (3+4) series. The cirri are XVI, 12–13, 6 mm. long.

The smaller specimen has 14 arms. There is a single IIBr series on each of 4 rays, of which 3 are 4 (3+4) and 1 is 2.

The specimen without locality in the British Museum has 20 arms.

Localities.—Off the Tugela River mouth, north of Durban, Natal; Tugela River mouth bearing NW. by W., 3.5 miles distant; 25 meters; bottom, rocks [Bell, 1905; A. H. Clark, 1911].

Durban (Port Natal), Natal; Wahlberg [J. Müller, 1843, 1849; Dujardin and Hupé, 1862; von Martens, 1869; P. H. Carpenter, 1879, 1883, 1888; Bell, 1882; A. H. Clark, 1911, 1912, 1915, 1918]. (2, U.S.N.M., 35111; Berl. M., 1060). Pl. 65, fig. 183.

Off Algoa Bay, close to Riy Bank, near Port Elizabeth (lat. 33° 58′ S., long. 25° 51′ 30″ E.); 46 meters; bottom dark sand, black specks, and rocky; also given as station 508A [Bell, 1905; A. H. Clark, 1911, 1913] (20, B. M.).

False Bay, Cape of Good Hope; 31 meters [Bell, 1905; A. H. Clark, 1911, 1913] (10, B. M.).

Cape of Good Hope; M. Reynaud, 1829 [Dujardin and Hupé, 1862; P. H. Carpenter, 1888; A. H. Clark, 1911] (2, P. M.).

Cape of Good Hope [A. H. Clark, 1913] (7, B. M.).

Cape of Good Hope; U. S. Exploring Expedition [Hartlaub, 1912].

Pieter Faure station 18282; Simons Bay, False Cape; 15–18 meters; rocks [H. L. Clark, 1923] (3, M. C. Z., 741; South African Mus.).

Gauss; Simons Bay; July 15–16, 1903 [A. H. Clark, 1915] (2, Berl. M.).

Challenger; Simons Bay; 18–36 meters [P. H. Carpenter, 1888; A. H. Clark, 1911, 1913] (1, B. M.).

No locality [A. H. Clark, 1913] (1, B. M.).

Geographical range.—South Africa, from the Tugela River, Natal, to the Cape of Good Hope and Simons Bay.

Bathymetrical range.—From the shore line down to 46 meters; the average of 5 definite records is 27 meters.

History.—This species was originally described in 1843 by Johannes Müller from a number of specimens in the Museum of the Academy of Sciences (now the Riks-Museum) at Stockholm which had been collected by Dr. J. A. Wahlberg at Port Natal (now Durban). It was redescribed and discussed at some length by Müller in 1849.

Dujardin and Hupé in 1862 published a translation of Müller's original description. In their monograph they gave a list of names which they found with specimens in the Paris Museum, among which was *Comatula coccodistoma*. I found this name with 2 specimens of *Comanthus wahlbergii* which had been collected by M. Reynaud at the Cape of Good Hope in 1829, and 1 specimen of *Capillaster coccodistoma* collected at Madagascar by M. Rousseau in 1841.

In 1869 Prof. E. von Martens, on the strength of Müller's description, noted this species from Natal.

In 1879 Dr. P. H. Carpenter identified *wahlbergii* as an *Actinometra*, and in another paper mentioned its occurrence in the *Challenger* collection.

Prof. F. Jeffrey Bell in 1882 gave a specific formula for this type, which was emended early in 1883 by Carpenter.

In the *Challenger* report on the comatulids published in 1888 Carpenter wrote that two years after making his first communication on the subject of the species of comatulids Müller described a 20-armed form from Natal in the Stockholm Museum under the name of *Alecto wahlbergii*. It has no IIIBr series, and further differs in several minor points from the types of *Comatula parvicirra* and *Comatula timorensis*, so that he was for a long time inclined to regard it as specifically distinct. But he said that at last he had been obliged to abandon this view, and now considered the type as another variety of *parvicirra*. He therefore listed the single specimen secured by the *Challenger* at Simons Bay under *Actinometra parvicirra*, and also mentioned the Cape of Good Hope and Port Natal among the localities where this form is found.

In 1905 Bell recorded *parvicirra* from various localities in South Africa, and also inadvertently included specimens of *wahlbergii* under *Antedon capensis* (= *Tropiometra carinata*).

In March, 1911, I gave the characteristic features of *wahlbergii* in detail and pointed out that this form is very sharply separated from *parvicirra*, not even belonging in the same specific group, but having its closest affinity with *trichoptera* of southern Australia, its presence at the Cape indicating a connection between the crinoid faunas of these two localities similar to that shown in many other groups. In the same year I recorded the 2 specimens which I had seen at the Paris Museum bearing the manuscript name *Comatula coccodistoma*.

In my monograph on the crinoids of the Indian Ocean published in 1912, *wahlbergii* was maintained as a distinct species, and the synonymy and the range were given.

In 1913 I published an annotated list of the specimens of this species in the collection of the British Museum, together with the references to them in the literature.

In 1915 I recorded and gave notes upon some specimens secured by the *Gauss* at Simons Bay, and in 1918, in my report upon the unstalked crinoids of the *Siboga* expedition, I inserted this species in a key to the species of *Comanthus*.

In 1923 Dr. Hubert Lyman Clark recorded 3 additional specimens which had been collected by the *Pieter Faure* in Simons Bay, and in the same year in a list of the crinoids of the Atlantic I gave its range.

COMANTHUS SAMOANA A. H. Clark

Plate 78, Figure 208; Plate 81, Figures 219, 220

[See also vol. 1, pt. 2, figs. 428, 429 (pinnule tip), p. 257; figs. 649–651 (comb), p. 327]

Actinometra trachygaster Lütken, Mus. Godeffroy Cat., vol. 4, 1869, p. 125 (Samoa; Fiji; *nomen nudum*); vol. 5, 1874, p. 190 (Samoa; *nomen nudum*).—Greeff, Sitzungsber. d. Gesellsch. zur Beförderung d. gesammten Naturwiss. zu Marburg, No. 1, Jan. 1876, p. 19 (anatomy).—Ludwig, Zeitschr. f. wiss. Zool., vol. 28, 1877, p. 225 and following (anatomy).—Lütken, Mus. Godeffroy Cat., vol. 5, 1877, p. 100 (Samoa; Tonga; Pelew Is.; *nomen nudum*).—Ludwig, Morphol. Studien an Echinodermen, 1879, p. 1 (anatomy).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29, footnote[3] (named but not described by Lütken); *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 127 (absence of sacculi); vol. 26, pt. 60, 1888, pp. 53, 310, 315 (different types under this name).—Perrier, Nouv. archives du mus. d'hist. nat., Paris, ser. 2, vol. 9, 1886, p. 116 (anatomy).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 96 (in part; MS. name of Lütken found with specimens of *parvicirra*).—A. H. Clark, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (in part; identity); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (B. M., MS. = *Comanthus samoana;* Samoa).

Actinometra parvicirra (part) P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 519 (Peru).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 168 (Peru).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 338 (see beyond).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, pp. 97, 98 (see beyond).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).

Actrinometra trachygaster Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 97 (part; MS. name of Lütken found on specimens of *parvicirra*).

Actinometra parvicirra typus A Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 97 (Amboina; Peru; Samoa).

Comanthus (*Comanthus*) *samoana* A. H. Clark, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 30 (description; Samoa).

Comanthus (*Comanthus*) *rotalaria* (part) A. H. Clark, Vidensk. Medd fra den naturhist. Forening i København, 1909, p. 144 (?Australia; notes).

Comanthus samoana A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 181 (cirri compared with those of the type of *Alecto timorensis* and of 2 specimens of *parvicirra* from the Solor Is.); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 248 (New Caledonia; Sulu Is.; notes); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 9 (Tonga and Fiji; Samoa; recorded by Hartlaub as *parvicirra;* Ruk; description; Abrolhos Is.; descriptions of specimens); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 391 (Samoa; no locality); Crinoids of the Indian Ocean, 1912, p. 36

(=*Actinometra parvicirra*, part, of P. H. Carpenter, 1888); p. 37 (=*Actinometra parvicirra*, in part, of Hartlaub, 1891); p. 95 (synonymy; Invisible Bank; description; summary of previous records; comparison with *parvicirra*); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 309 (Abrolhos Is.; description; also Samoa, Tonga, Fiji, New Caledonia, Sulu, and Ruk); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 17 (Samoa; no locality; characters of one of the specimens); Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 113 (already recorded from Abrolhos); Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, p. 223 and following (detailed account of the distribution in Australia); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 49 (in key; range); pp. 271, 273, 275 (listed).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 8 (secured by the Carnegie Exped., 1913); p. 19 (Mer; Badu; range); pp. 192 and following (range); pl. 20, fig. 4.

Comanthus (*Bennettia*) *samoana* A. H. Clark, Records of the Australian Mus., vol. 9, No. 1, 1912, p. 82 (Ugi, Solomon Is.).

Comanthus parvicirra (part), A. H. Clark, Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 10 (Peru).

Comanthus luteofuscum H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 102 (Mer; description).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 56 (synonym of *parvicirra*).

Comanthus samoanum H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 103 (Mer); Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 84 (Ceylon; notes); p. 93 (occurs at Ceylon).

Comanthus (*Cenolia*) *samoana* A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 52 (references; stations 50, 162, 299; notes).

Comanthus luteofusca H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 8 (secured by the Carnegie Exped., 1913); p. 18 (occurrence at Mer; probably the same as *samoana;* discussion; color); p. 192 and following (range); pl. 20, figs. 2, 3; Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 234.

Diagnostic features.—The cirri are numerous, rather short, but strong and rather stout, and strongly recurved in the distal portion. They are usually about XX (varying from XI to XXVI), 15 (12–17), 9 or 10 mm. (from 8 to 12 mm.) in length.

The arms are usually 20, or about 20 (varying from 15 to 39), in number, and usually between 60 and 70 mm. (varying from 40 to 105 mm.) in length.

There is an excessive development of minute spines on the distal edges of the brachials and pinnule segments which gives this species, especially when preserved in alcohol, a characteristic "dry" feeling which is quite different from the "soft" feeling of *C. parvicirra*.

The following description is based upon the type and cotypes collected by Sir Charles N. E. Eliot in Samoa:

Description.—The centrodorsal is small, discoidal, with the bare polar area flat, from 2 to 3 mm. in diameter. The cirrus sockets are arranged in a single more or less irregular marginal row.

The cirri are XVIII–XXIII, 12–15 (usually 13–14), 10 mm. long, short, but comparatively stout, and always strongly curved. The first 2 segments are about twice as broad as long, the third is about as long as broad, the fourth and fifth are about twice as long as broad, the sixth is about as long as broad, and the remainder are about one-third again as broad as long. The fifth and following segments have the distal dorsal edge somewhat thickened, this thickening gradually narrowing distally and increasing slightly in height, appearing in lateral view as a slight subterminal tubercle. The opposing spine is median or submedian, low, with the apex sharp in lateral view, but in end view transversely elongate or double. The terminal claw is longer than the penultimate segment, stout, and moderately curved. The third, fourth, and fifth segments are constricted centrally with enlarged ends and are rounded in cross section. The following segments are rather strongly flattened laterally, so that in a lateral view the cirri appear to increase in width distally. In some specimens the distal ends of the cirrus segments are slightly overlapping, giving the cirri a peculiar rough appearance.

The radials are concealed by the centrodorsal. The IBr_1 are usually entirely concealed except in the interradial angles of the calyx. The IBr_2 (axillaries) are triangular, twice as broad as long, just in apposition laterally. The IIBr series are 4 (3+4), the series usually being slightly deficient. The IIIBr series are 4 (3+4), but are only developed in a single individual.

The arms are 15–21 in number, from 60 to 70 mm. in length, rather slender. The first brachials are nearly oblong, about three times as broad as the exterior length, and almost entirely united interiorly. The second brachials are more wedge-shaped, of about the same size, free interiorly. The first syzygial pair (composed of brachials 3+4) is oblong, from two to two and one-half times as broad as long. The fifth brachial is oblong, about three times as broad as long. The following brachials are triangular, at first nearly as long as broad but soon becoming shorter, after the proximal third of the arm about twice as broad as long, and in the terminal portion wedge-shaped and slightly longer. The brachials after the fourth develop rather strongly everlapping distal ends, this character gradually becoming obsolete in the distal half of the arms.

Syzygies occur between brachials 3+4, again in the vicinity of the twelfth brachial, and distally at intervals of 4 muscular articulations.

The disk is 10 mm. in diameter. The anal area is large, with rather numerous calcareous concretions. The mouth is marginal and the anal tube central.

P_D is 10 or 11 mm. long, rather slender, tapering evenly in its proximal two-thirds and becoming very slender in its distal third, composed of nearly 30 segments, which become about as long as broad on about the seventh. The terminal comb has 5–7 large rounded triangular teeth. The distal ends of the segments are produced dorsally and are armed with numerous coarse spines. The outer side of the distal dorsal edge also is more or less prominent and spinous, and the whole surface of the segments is studded with prominent, though small, spines. As the pinnule decreases in width distally the spinous processes on the segments gradually become less prominent. P_1 is similar to P_D and of about the same size. P_2 is smaller and more slender, 4 mm. long. P_3 is similar to P_2, but usually very slightly shorter and more slender. P_4 and the following pinnules are somewhat stouter and taper less rapidly, but the distal pinnules become more slender again and reach 5 mm. in length. The genital pinnules have slightly prominent spinous distal ends, and the segments of all the pinnules are armed with larger and more numerous spines than usual, the recurved spines on the terminal 2 or 3 segments being correspondingly enlarged, so that the pinnules have a peculiar and characteristic harsh feeling and cling tenaciously to anything that will afford a hold, such as cloth or the fingers.

The color in alcohol is dark brown, becoming buff on the arm tips; the cirri buff.

Notes.—As described by Dr. H. L. Clark, the specimen from Ceylon has 25 arms, and the cirri are XXIV, 15–17.

The specimen from Invisible Bank is slightly larger than any of those at hand from Samoa. The 20 arms are 70 mm. long. The bare polar area of the centrodorsal is 3 mm. in diameter. The cirri are XXV, 13–14, 9 mm. long, and are arranged in a single crowded and irregular row.

The specimen from *Siboga* station 50 has 20 arms 80 mm. long. All of the IIBr series are present, and all are 4 (3+4).

The example from *Siboga* station 299 has 20 arms 65 mm. long. All of the IIBr series are present, and all are 4 (3+4). The cirri are XVII and are rather more slender than usual.

Hartlaub gives the following characters from the 12 specimens from Amboina which he determined as *Actinometra parvicirra* typus A:

The centrodorsal is fairly large, circular, and flat.

The cirri are XVI–XXV, usually 15–16, and are relatively thick.

The radials, and sometimes even the IBr_1, are entirely concealed by the centrodorsal. The IIBr series are mostly 4 (3+4), and only a few specimens have some of 2 elements.

There are 20 arms, only 2 specimens having 21, resulting from the presence of a single IIIBr series.

The color is a fairly dark uniform chocolate brown.

Hartlaub remarked that these specimens are in general markedly smaller than those of typus B (*parvicirra*) and are characterized by the absence of IIIBr series, which are very common in the latter.

The specimen collected at Amboina by the Danish expedition to the Kei Islands has 24 arms which are about 80 mm. long. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. Of the 4 IIIBr series, 3 are 4 (3+4), all external, and 1 is 2, internal. The cirri are XV, 11–12. The gonads are greatly swollen. Combs occur at intervals to the ends of the arms as preserved. The color is dorsally brownish yellow, with the centrodorsal and cirri lighter; the ventral surface and the gonads are violet.

The specimen from *Siboga* station 162 is small, with 13 arms about 40 mm. long, and is undergoing adolescent autotomy.

The specimen from the Abrolhos Islands has 18 arms about 50 mm. long. The IIBr series are all 4 (3+4). The cirri are about XXV, 17, 12 mm. long. The longest cirrus segments (the fourth or fifth) are twice as long as broad or slightly longer, and the distal cirrus segments are twice as broad as long. The disk is thickly covered with small but prominent calcareous nodules of approximately equal size.

One of the 2 specimens presumably from Western Australia in the Copenhagen Museum has 28 arms about 70 mm. long. The cirri are robust, XXIII, 13, from 8 to 10 mm. long. The other is similar.

One of the specimens from Mer (541) is small, with 20 arms about 40 mm. long. The 6 IIBr series remaining attached are all 2. There are no further division series. The cirri are XIV, 13–15, strong and functional.

Another specimen (542) has 24 arms. Of the IIBr series, 7 are 2, 2 are 4 (3+4), and 1 is missing. The bare dorsal pole of the centrodorsal is slightly concave, 2.5 mm. in diameter. The cirri are XI, 14.

One of the examples from the southwest reef at Mer (538) has 23 arms about 60 mm. long. The cirri are XIII, 14–16. The other (539) has 29 arms about 65 mm. long. One of the IIBr series is 2, all the other division series being 4 (3+4). The cirri are XI, 14–15.

Five other specimens from this locality (537) have 20, 21, 22, 25, and 29 arms.

The specimen taken on the southwest reef on September 29, 1913, has 24 arms about 65 mm. long. Of the IIBr series, 6 are 4 (3+4) and 4 are 2. The cirri are XX, 15–16, with several not fully formed.

This is the type of *Comanthus luteofuscum* H. L. Clark which was thus described.

The centrodorsal is small, thick, with the bare dorsal surface flat or a trifle concave, 2 mm. in diameter.

The cirri are XVIII–XXII, 13–17, rather short, about 10 mm. long. Except for the fourth-seventh the cirrus segments are short, and broader than long. Except for 7 or 8 basal segments, each segment has a dorsal elevation of more or less prominence. This may be a tubercle, a spine, or a rough transverse ridge: it is often conspicuous.

The radials are in close lateral apposition. The IBr $_1$ are notably broader than the IBr $_2$ (axillaries) and in broad lateral contact. The axillaries are almost triangular, very short and broad, and well separated laterally. The IIBr series are usually 4 (3+4), but occasionally 2. The IIBr $_1$ are in close contact interiorly. The IIIBr series are usually 4 (3+4), but sometimes 2. The IIIBr $_1$ are in contact interiorly.

The 20–30 arms are notably short, from 50 to 60 mm. in length, usually approximately equal, "but sometimes distinctly longer on one side of the animal than on the other." Each arm is made up of from 80 to 100 brachials, which, except at the arm tip, are low, more or less discoidal, and have everted and finely serrate distal margins, particularly near the middle of the arm. The first brachials are in contact interiorly.

Syzygies occur between brachials 3+4, 10+11, or 11+12, and distally at intervals of from 4 to 6 muscular articulations.

The oral pinnules have 30 or more segments, of which 8 or more make up the comb. The arm pinnules have only a dozen segments. Even the distal pinnules are short. The pinnules at the base of the arm and near the middle are stout, and their component segments have everted and finely serrate distal ends.

The specimen from the Great Barrier Reef has 26 arms. Of the IIBr series, 5 are 4 (3+4) and 5 are 2. The cirri are XV, 15–17, with the distal portion strongly recurved.

The specimen from Ugi has 20 arms 60 mm. long. Of the 9 IIBr series, 6 are 4 (3+4) and 3 are 2. On one postradial series, which bears 2 IIBr series, there is a IIIBr series, developed externally.

Of the 2 specimens from New Caledonia 1 has 24 and the other 26 arms.

The specimen from Suau Point, Fiji, has the cirri XXII, 14.

The specimen labeled Tonga and Fiji in the Hamburg Museum has 39 arms.

The example from Tutuila has 20 arms about 60 mm. long. The bare dorsal pole of the centrodorsal is 3 mm. in diameter. The cirri are XVIII, 12–14; the fifth is a transition segment.

The specimen from Samoa in the Berlin Museum has 26 arms about 100 mm. long. Of the 10 IIBr series, 7 are 4 (3+4) and 3 are 2.

Of the 2 specimens labeled Samoa in the Hamburg Museum 1 has 21 arms with the single (external) IIIBr series 2, and all the other division series 4 (3+4). The other is similar.

Carpenter wrote that he examined 2 specimens from Peru in the Hamburg Museum which he thought must be referred to *parvicirra*. He could find no characters by which he could separate them from any one of the various forms that inhabit the eastern seas. One of them is very small and has lost its disk, but the other is larger and more perfect, though wanting some of its arms. The mouth is not quite so distinctly interradial as it is in the Philippine specimens which he described as *polymorpha*, but there is the same dimorphism of the arms. All of the arms are grooved, but the grooves on the posterior arms are much smaller and less distinct than those on the anterior arms and do not extend onto the pinnules. Some of the posterior arms consist of less than 50 brachials, while in the anterior arms there are more than 100. The terminal ungrooved pinnules of the former are also thicker and more clothed with perisome than those at the same distance from the calyx on the anterior arms. He was unable to find in these specimens any trace of spherodes.

The 4 specimens from Peru in the Hamburg Museum are all of medium size. One has 21 arms. The IIBr series which bears the single (internal) IIIBr series is 2, all the other division series being 4 (3+4). The cirri are IX, with some additional rudimentary, 16–17. Another has 20 arms with the 10 IIBr series 4 (3+4) and the cirri VI, 16–17. A third has 19 arms. Of the 8 IIBr series present, 5 are 4 (3+4) and 3 are 2. A single IIIBr series is developed on the inner side of a postradial series bearing 2 IIBr 2 series. The fourth specimen is rather smaller than the others. It has 18 arms, 8 IIBr 4 (3+4) series being present.

The specimen from Ruk has 23 arms and the cirri VIII, 11–12. The centrodorsal is especially small.

The specimen from Port Galera, Mindoro, has 20 arms about 105 mm. in length. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. The cirri are numerous and closely crowded in a single irregular row on a thin discoidal centrodorsal, about XX, 13–14, strongly recurved distally. The longer proximal segments are twice as long as their median width. The distal segments are broader than long and are much compressed laterally, so as to appear broader than those preceding in lateral view.

Remarks.—Dr. Clemens Hartlaub in 1891 was the first to distinguish this form under the heading typus A of *parvicirra*. According to Hartlaub, typus A is characterized by having a fairly large flat circular centrodorsal, with the cirri XXV and relatively thick; IIIBr series are absent, or at least only very rarely present; the size is markedly smaller than in typus B (true *parvicirra*); the color, in the specimens from Amboina, is a fairly dark uniform chocolate brown, a color never found in typus B (*parvicirra*).

In 1915 Dr. Hubert Lyman Clark described *Comanthus luteofuscum*, which he said is obviously closely allied both to *parvicirra* and to *annulata*, but is readily distinguished by the short arms, the well-developed, rather short, cirri, the character of the brachials and of the pinnules, which have everted and finely serrate distal ends, and the distinctive coloration. He identified some other specimens taken at the same time as *samoana*.

In 1921 he wrote that, whereas I had at first considered *luteofuscum* a synonym of *parvicirra*, since examining his material I had suggested that *luteofuscum* is identical with *samoana*, and after a comparison of specimens he thinks that I am probably correct. But he found that there were 2 forms in the collection of the Museum of Comparative Zoology from Mer, both of which I had identified as *samoana*.

He says that one of these has very rough cirri and is what he has called *luteofusca*, while the other has smooth cirri, and he has called it *samoana*. He writes that I have labeled one of the latter "nearly typical *samoana*."

He continues that he is not prepared to say whether these 2 forms represent different species or not. They are easily distinguished from each other, but he hardly thinks that the difference will prove reliable. His first thought was to let *luteofusca* stand as the name for the form with the rough cirri, and to use *samoana* as the name of those which have the cirri smooth. But he remarks that reference to my original description of *samoana* unfortunately shows that my types are the form with rough cirri. Hence it is the form with smooth cirri which lacks a name. He concludes that for the present the matter may rest, awaiting light on the relationship of the 2 forms.

These 2 specimens were sent to me in Washington, compared with the types of *samoana*, and returned. I do not now remember the circumstances, and can not say whether the determination was made on the basis of the characters as a whole or whether, in repacking, the labels became exchanged.

Carpenter and Hartlaub assumed that "Peru," the locality attached to 4 specimens in the Hamburg Museum, is the country of that name in South America. It is much more likely that it is Peru, or Francis Island, in the Gilbert or Kingsmill group.

Professors Pfeffer and Michaelsen tell me that the specimens collected by Vierau form part of a very old collection and that the localities as given are unreliable.

Although when typically developed the 2 forms are very different, this species seems to intergrade to a certain extent with *C. parvicirra*.

Localities.—Ceylon [H. L. Clark, 1915].

Invisible Bank, about 36 miles east of the Sisters, Andaman Islands (lat. 11° 29′ to 10° 59′ N., long. 93° 30′ E.) [A. H. Clark, 1912] (1, I. M.).

Siboga station 50; Bay of Badjo, western coast of Flores; down to 40 meters; mud, sand, or shells, according to locality; April 16–18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 299; Boeka or Cyrus Bay, southern coast of Rotti, southwest of Timor (lat. 10° 52′ 24″ S., long. 123° 01′ 06″ E.); 34 meters; mud, coral, and lithothamnion; January 27–29, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Amboina; Dr. J. Brock [Hartlaub, 1891].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Bay of Amboina; about 50 meters; stones and sand; February 21, 1922 (1).

Siboga station 162; between Loslos and Broken Islands, western coast of Salawatti (west of New Guinea); 18 meters; coarse and find sand, with clay and shells; August 18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Abrolhos Islands (Houtmans Rocks), Western Australia [A. H. Clark, 1913] (1, H. M.).

?Western Australia (the label reads ?New Holland); Museum Godeffroy [A. H. Clark, 1909, 1912 (as ?Australia)] (2, C. M.). Pl. 81, figs. 219, 220.

Southwest Reef, Mer, Murray Islands; H. L. Clark, September 29, 1913 [H. L Clark, 1915, 1921] (1, M. C. Z., 536).

Southwest Reef, Mer [H. L. Clark, 1915, 1921] (5, M. C. Z., 537).

Mer; reef flat [H. L. Clark, 1915, 1921].

Mer; H. L. Clark, October, 1913 [H. L. Clark, 1915, 1921] (10, M. C. Z., 541, 542, 548, 585).

Mer; September 29–30, 1913 [H. L. Clark, 1915, 1921] (24, M. C. Z., 580).

Southwest Reef, Mer [H. L. Clark, 1915, 1921] (2, M. C. Z., 538, 539).

Great Barrier Reef, 4 miles eastnortheast of Mer; H. L. Clark, October 15, 1913 (1, M. C. Z., 540).

Badu, Mulgrave Island, Torres Strait [H. L. Clark, 1921].

Torres Strait (1, M. C. Z., 612).

Ugi, Solomon Islands [A. H. Clark, 1912] (1, Austr. M.).

New Caledonia; M. Reveillière, 1880 [A. H. Clark, 1911, 1912, 1913] (2, P. M.).

Suau Point, Vauna Mbalavu, Fiji; beach; Alexander Agassiz, November 25, 1897 (1, M. C. Z., 206).

Fiji [Lütken, 1869; A. H. Clark, 1912, 1913].

Tonga and Fiji [A. H. Clark, 1912, 1913] (1, H. M.).

Tonga Islands [Lütken, 1877; A. H. Clark, 1912, 1913].

Tutuila, Pago Pago, Samoa (2, M. C. Z., 733, 740).

Samoa; Sir Charles N. E. Eliot [A. H. Clark, 1909, 1912, 1913] (4, U.S.N.M., 25514, 35062). Pl. 78, fig. 208.

Samoa; Museum Godeffroy [A. H. Clark, 1912, 1913] (1, Berl. M., 1659).

Samoa [Lütken, 1869, 1874, 1877; P. H. Carpenter, 1888; Hartlaub, 1891; A. H. Clark, 1912, 1913] (4, B. M.; H. M.).

Gilbert (Kingsmill) Islands (2, M. C. Z., 205).

Peru; probably Peru or Francis Island in the Gilbert group (about lat. 1° 30′ S., long. 176° E.); Vierau [P. H. Carpenter, 1882, 1888; Bell, 1884; Hartlaub, 1891; A. H. Clark, 1912] (4, H. M.).

Ruk, Caroline Islands [A. H. Clark, 1912, 1913] (1, H. M.).

Pelew Islands [Lütken, 1877].

Port Galera, Mindoro, Philippines; Dr. Laurence E. Griffin (1, M. C. Z., 675).

Jolo (Sulu) Archipelago; Dr. Montano y Rey, 1880 [A. H. Clark, 1911, 1912, 1913] (1, P. M.).

No locality [A. H. Clark, 1912, 1913] (2, B. M.; Berl. M., 4134).

Geographical range.—From Ceylon to tropical Australia, south to the Abrolhos Islands, Western Australia, and Torres Strait, the Solomon Islands, New Caledonia, Fiji, Tonga, Samoa, the Gilbert, Caroline, and Pelew Islands, and the Philippines; apparently scarce in the Malayan Archipelago.

Bathymetrical range.—From the low-tide mark down to 40 meters. Nearly all of the known specimens are from very shallow water.

History.—In the early catalogues of the Godeffroy Museum published in 1869, 1874, and 1877 Prof. C. F. Lütken included the name *Actinometra trachygaster*, giving as localities for this undescribed form Samoa, Fiji, Tonga, and the Pelew Islands.

In 1876 Dr. R. Greeff, and in 1877 and 1879 Prof. Hubert Ludwig, discussed certain morphological features of *Actinometra trachygaster*, their information being obtained from specimens secured from the Godeffroy Museum which had been named by Lütken. They did not mention any of the systematic characters presented by their specimens, nor did they mention the localities whence they had come. While there is little doubt that *samoana* was the form they had, there is a possibility that it might have been *parvicirra*. The work of Greeff and Ludwig on *Actinometra trachygaster* was referred to by Carpenter in 1884 and by Perrier in 1886.

In 1879 Carpenter noted that Lütken had applied this name to a new species, but had not, so far as he knew, described it.

In 1882 Carpenter published some notes on 2 specimens from Peru in the Hamburg Museum which he identified as *parvicirra*.

He assumed, as have all subsequent authors, that Peru was the west South American country of that name. In 1909 I suggested[8] that the Peru in question must be Peru (or Francis) Island, situated in about lat. 1° 30′ S., long. 176 ° E., in the Gilbert or Kingsmill group.

In 1888 Carpenter said that in the different collections which he had examined he had found a considerable variety of types under the name *Actinometra trachygaster*. In his discussion of the species of the *Valida* group, consisting of forms with the IIBr series 2 and the first syzygy between brachials 3+4, he said that some of the individuals which had been distributed by the Godeffroy Museum under this name have one or more division series of 4 (3+4) beyond the IIBr 2 series, while others have the IIBr series 4 (3+4).

He did not mention *Actinometra trachygaster* further, and although some of the specimens from which he took the localities given under *Actinometra parvicirra* bore this name, he did not include it in the synonymy of that form.

Dr. Clemens Hartlaub in 1891 definitely placed *Actinometra trachygaster* in the synonymy of *parvicirra* and mentioned 2 specimens from Samoa which he found under that name in the Hamburg Museum.

In his treatment of *Actinometra parvicirra* he divided the species into 2 types, which he called A and B. Under type A he described 12 specimens from Amboina, and he also assigned to it 4 specimens from Peru and the 2 from Samoa in the Hamburg Museum.

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[8] Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 127, footnote.

Hartlaub's *Actinometra parvicirra* type A corresponds to the form here treated as *Comanthus samoana*, while his *Actinometra parvicirra* type B corresponds in the main to *Comanthus parvicirra*, but also includes some specimens of *C. timorensis*.

In 1909, on the basis of 4 specimens from Samoa which had been presented to the United States National Museum by Sir Charles N. E. Eliot, I described *Comanthus* (*Comanthus*) *samoana* as a new species. These specimens were very obviously different from any examples of *parvicirra* which I remembered having seen, but on reexamining the collection of the Copenhagen Museum, which was then in Washington and on which I had already submitted a report for publication, I found that 2 specimens from ?New Holland which I had identified as *parvicirra* agreed with my new form. In the report on the Copenhagen collection these are given under *Comanthus* (*Comanthus*) *rotalaria*, the name which I at that time employed for *parvicirra*, and the locality is given as ?Australia. At the time these were collected New Holland was used chiefly to designate Western Australia, and I believe that that is the region whence they came.

In 1911 I recorded and gave notes upon 2 specimens from New Caledonia and one from the Jolo Archipelago in the Paris Museum. In 1912 I recorded several others which I had seen in the collection of the Hamburg Museum. Among the specimens of *C. parvicirra* listed in my paper on the crinoids of the Hamburg Museum the 4 from Peru should have been assigned to *samoana*. In a paper on the crinoids of the Berlin Museum which was also published in 1912 I mentioned and gave notes upon 2 specimens in that institution.

In my monograph of the crinoids of the Indian Ocean published in 1912 I recorded and described a specimen from the Invisible Bank, and gave a synonymy and a list of previously ascertained localities. Among these was ?Australia, which refers to the specimens in the Copenhagen Museum, although there was no explanation of that fact.

In a paper on the crinoids of the Solomon Islands published in 1912 I recorded and gave notes upon a specimen from Ugi.

In 1913 in a supplement to my memoir on the crinoids of southwestern Australia (1911) I republished the description of the specimen from the Abrolhos Islands recorded in the preceding year. In another paper published in 1913 I recorded 3 specimens which I had examined in the British Museum in 1910. Two of these, from Samoa, bore the name *Actinometra trachygaster*. It was from these and 2 others from Samoa in the Hamburg Museum bearing the same name that I learned of the identity of my *samoana* and Lütken's *trachygaster*.

In 1915 Dr. Hubert Lyman Clark recorded *C. samoanum* from Mer, where he said that only a few specimens were found. They occurred with, and were not recognized as distinct from, *annulatum*; but on his return to Cambridge he found that they could at that time be distinguished without difficulty. In the same paper he described as a new species *Comanthus luteofuscum*, which he said was not at all rare on the reef flat at Mer, though it was nowhere abundant.

When I received his paper my manuscript on the comatulids of the *Siboga* expedition was practically completed. Largely on the strength of his statement that *luteofuscum* is obviously closely allied to both *parvicirrum* and *annulatum*, and overlooking the mention of the well-developed and numerous cirri, I placed it in my report (1918) in the synonymy of *parvicirra* without comment.

In another paper published in 1915 Doctor Clark recorded and gave notes upon a specimen of *samoanum* from Ceylon.

In 1921 he said that since examining his material I had suggested that *luteofusca* is identical with *samoana*, and after a comparison of specimens he thinks that I am probably right.

Subgenus COMANTHUS A. H. Clark

Validia A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 142 (in intent; genotype *Comatula rotalaria* Lamarck, 1816, which is assumed to have the characters given in the redescription by Carpenter, 1888).

Vania A. H. CLARK, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 457 (no diagnosis; mentioned with a single species called here *Comanthus* [*Vania*] *annulata*); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 756 (characters; range; new name for *Validia* as originally intended; genotype *Alecto parvicirra* J. Müller, 1841); Crinoids of the Indian Ocean, 1912, p. 11 (represented in the Ceylon region); p. 12 (represented in the Red Sea region and in the southeast African region); p. 95 (diagnosis; genotype; same as *Validia* in intent); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 34 (in key; range); p. 48 (subgenus of *Comanthus*; in key).—GISLÉN, Nova Acta reg. Soc. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 53 (characters); p. 56 (discussion).

Comanthus (*Validia*) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 18.

Comanthus (*Vania*) A. H. CLARK, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, pp. 457, 465, 466.—GISLÉN, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 52 (pinnule combs).

KEY TO THE SPECIES OF THE SUBGENUS COMANTHUS

*a*¹. Not less than 30 arms; size medium or large; functional cirri usually absent, such cirri as are present being more or less undeveloped, and cirri being frequently altogether absent (Ceylon and southern India to tropical Australia, Tonga, and Fiji, the Bonin Islands, the Philippines, and Formosa (Taiwan); 0–73 [?100] meters) .... timorensis, p. 603.

*a*². Not more than 30 arms; size small; a greater or lesser number of functional cirri almost invariably present (Madagascar, Mauritius, the Seychelles, and Baluchistan to tropical Australia, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, and Amoy, China; 0–110 meters) .... parvicirra, p. 631.

COMANTHUS TIMORENSIS (J. Müller)

Plate 64, Figure 181; Plate 75, Figure 204; Plate 76, Figure 205; Plate 77, Figures 206, 207

[See also vol. 1, pt. 1, fig. 82 (dorsal view), p. 135; pt. 2, pl. 17, fig. 1076 (oral pinnule)]

Alecto timorensis (Mus. Leyd., MS.) J. MÜLLER, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 186 (description; Timor); Archiv f. Naturgesch., 1841, vol. 1, p. 145 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 216 (structure).—A. H. CLARK, Notes from the Leyden Mus., vol. 33, 1911, p. 176 (identity); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 711 (history; identity).

Comatula timorensis J. MÜLLER, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 263 (redescribed).—DUJARDIN and HUPÉ, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 206 (synonymy; description; Timor).—P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (unable to place this in *Antedon* or *Actinometra*).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Actinometra intricata LÜTKEN, Mus. Godeffroy Cat., vol. 5, 1874, p. 190 (Tonga; Fiji; *nomen nudum*); vol. 5, 1877, p. 100 (Port Denison; Tonga; Fiji; *nomen nudum*).—VON GRAFF, *Challenger* Reports, vol. 10, pt. 27, 1884, pp. 14, 19, 37 (Tonga; myzostomes).—P. H. CARPENTER, *Challenger*

Reports, Zoology, vol. 26, pt. 60, 1888, p. 315 (Fiji; Tonga; Samoa; proposes eventually to describe it).—BRAUN, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; from von Graff).—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 96 (in synonymy of *parvicirra;* Tonga).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 441 (history); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (identity).

Actinometra, sp. (part) P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 41, footnote 2.

Actinometra polymorpha (part) P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 53 (varieties 3, Bohol, and 4, Ubay); pl. 1, fig. 16; pl. 2, figs. 7, 11; pl. 3, fig. 3; pl. 6, figs. 20–24.

Actinometra parvicirra (part) P. H. CARPENTER, Notes from the Leyden Mus., vol. 3, 1881, p. 204 (East Indies); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 338.—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 97 (Amboina, Mortlock I., Lombock Strait, Fiji, Tonga [2], Atjeh).—DÖDERLEIN, Denkschr. d. medicin.-naturwiss. Gesellsch. Jena, ser. 8, vol. 5, 1898, p. 479 (Amboina).—CHADWICK, Report Ceylon Pearl Oyster Fisheries, pt. 2, suppl. rep. 11, 1904, p. 158 (Stations IX, XLVI, LIV, LVII, LXIII, LXIX; notes).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 717 (includes *annulata* Bell); p. 720 (Döderlein's specimens from Amboina include *annulata* [*timorensis*] and *parvicirra*).

Antedon, sp. BELL, Ann. and Mag. Nat. Hist., ser. 5, vol. 10, September 1882, p. 225 (Ceylon; notes).—WALTER, Jenaische Zeitschr., vol. 18, 1885, pp. 380, 381 (from Bell).

Actinometra meyeri P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 16, No. 95, Sept. 26, 1882, p. 525 (characters; Australia; also Philippines); Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 713 (history); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (identity).

Actinometra annulata BELL, Proc. Zool. Soc. London, October, 1882, p. 535 (description; Cape York); pl. 35.—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 747 (specific formula).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 713 (history).

Actinometra valida P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 314 (description; Prince of Wales Channel, 8 fathoms); pl. 59, fig. 3.—HAMANN, Jenaische Zeitschr., vol. 23, neue Folge 16, 1889, p. 234 (anatomy); Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. CLARK, Memoirs Australian Mus., vol. 4, pt. 15, 1911, pp. 716, 717 (identity with *meyeri* and *annulata*); Crinoids of the Indian Ocean, 1912, p. 35 (identity with *annulata*).—H. L. CLARK, The Echinoderm Fauna of Torres Strait, 1921, p. 5 (identity).

Actinometra littoralis P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 346 (description; Banda, 17 fathoms); pl. 67, figs. 1, 2.—HAMANN, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 36 (identity with *annulata*).

Actinometra guttata HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, pp. 96, 98 (MS. name of Lütken found on specimens of *parvicirra* from Fiji).—A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (identity).

Actinometra intricata HARTLAUB, Nova Acta Acad. German, vol. 58, No. 1, 1891, p. 98 (MS. name of Lütken found on specimens from Tonga).

Actinometra litoralis PFEFFER, Senck. Gesellsch. Abhandl., vol. 25, 1900, p. 85 (Ternate).

Comaster valida A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Comaster littoralis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia littoralis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Phanogenia valida A. H. CLARK, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus intricata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 220 (description; Bowen, Queensland); Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus rotalaria (part) A. H. CLARK, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 365 (Timor).

Comanthus littoralis A. H. CLARK, Zool. Anzeiger, vol. 34, No. 11–12, 1909, p. 366 (listed).

Comanthus (*Comanthus*) *valida* A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 143 (includes *intricata* and *littoralis;* Bowen; description of the type of *intricata*).

Comanthus (*Comanthus*) *rotalaria* (part) A. H. CLARK, Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 144 (Tonga Is.; Fiji; Singapore).

Comanthus parvicirra A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 181 (part; Indian Ocean; Timor).—R. H.[orst], in A. H. Clark, Notes from the Leyden Mus., vol. 33, 1911, p. 192 (Atjeh).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 97 (part; Galle; Port Blair); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 392 (part; Batjan).—Reichensperger, Abhandl. d. Senck. naturf. Ges., vol. 35, Heft 1, 1913, p. 88 (part; Aru Is.).

Comanthus (*Comanthus*) *annulata* A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 536 (*Albatross* stations 5321, 5599; Tulayan I.; identity of *annulata* and *valida*).

Comanthus valida A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 721 (occurs south to Bowen).

Comanthus annulata A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (East Indian species ranging south to Perth and Bowen); p. 443 (range on the east coast); p. 444 (range on the west coast); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 717 (known to P. H. Carpenter from Australia); p. 733 (in key); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 2 (identity with *meyeri*); p. 9 (notes on the type of *meyeri;* Tonga and Fiji, recorded by Carpenter and Hartlaub as *parvicirra*; South Passage, Shark Bay, 9 m.; notes on the specimens); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 392 (Friedrich-Wilhelms-Haven, New Guinea; St. Mathias I.; Batjan; Western Australia); Crinoids of the Indian Ocean, 1912, p. 35 (=*Actinometra valida* P. H. Carpenter, 1888); p. 36 (=*Actinometra littoralis* P. H. Carpenter, 1888; =*Actinometra parvicirra*, in part, P. H. Carpenter, 1888); p. 39 (=*Actinometra parvicirra*, in part Döderlein, 1898); p. 40 (=*Actinometra parvicirra*, in part, Chadwick; 1904); p. 96 (synonymy; southern portion of Malacca Strait; summary of previous records, range; discussion); Die Fauna Südwest-Australiens, vol. 4, Lief. 6, 1913, p. 309 (South Passage, Shark Bay, 9 m.; descriptions of specimens); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 17 (published references to specimens in the British Museum; localities represented by these; characters); Records of the Western Australian Mus., vol. 1, pt. 3, 1914e p. 115 (East Indian species; occurrence in the vicinity of Perth established); Internat. Revu. d. gesamt. Hydrobiol. u. Hydrogr., 1915, p. 223 and following (detailed account of the distribution in Australia).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 234 (New Guinea, No. 5943; St. Mathias I., No. 5940; specimen from Batjan is *parvicirra;* Western Australia, Nos. 5957, 6135).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 50 (in key; range); pp. 271–276 (listed).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 5 (history); p. 8 (secured by the Carnegie Exped., 1913); p. 16 (most noticeable comatulid at Mer; color; range); p. 192 and following (range); pl. 1, figs. 2, 8; pl. 3, fig. 3 (all colored); Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Abrolhos Is.); p. 233 (Wooded Isle; characters; remarks).

Comanthus (*Vania*) *annulata* A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 457 (localities; descriptions of specimens); pp. 465, 466 (association with other species); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 757 (annotated synonymy; characters; Port Denison; descriptions of specimens; additional Australian records; distribution; includes *meyeri, intricata,* and *valida*); Records of the Australian Mus., vol. 9, No. 1, 1912, p. 82 (Solomon Is.); Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (collected by the *Endeavour* in Western Australia); p. 120 (between Geraldton and Fremantle; characters of the specimens); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 53 (synonymy; notes; stations 43, 50, 89, 149, 209, 213, 273, 322).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 49 (Bock's station 42A; notes); p. 52 (combs); figs. 37–40, p. 44.

Actinometra gracilis (B. M., MS.) A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 76 (found in the British Museum under this name).

Comanthus callipeplum H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 102 (description; Mer).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 43, footnote (synonym of *Comantheria briareus*).

Comanthus annulatum H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 101 (exceedingly common at Mer; Friday I.; color in life); p. 107 and following (habits and reactions); Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 84 (Ceylon; notes); p. 92 (occurs at Ceylon); The Echinoderm Fauna of Torres Strait, 1921, p. 116 (host of *Ophiomaza cacaotica* and *O. obscura*).

Comanthus annulatum var. *xanthum* H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 102 (characters).

Comanthus annulatum xanthum A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 53 (synonym of *C. annulata*).

Comanthus callipepla H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 8 (collected by the Carnegie Exped., 1913); p. 17 (Mer; discussion; Philippines); p. 192 and following (range); pl. 1, fig. 1 (colored).

Comanthus annulata var. *xantha* H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 17 (Mer; color); pl. 1, fig. 6 (colored).

Vania annulata Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 54 (combs; Java, possibly a new species; characters).

Comanthus annulatus H. L. Clark, Records Australian Mus., vol. 15, No. 2, Nov. 18, 1926, p. 184 (Surprise Shoal, 7 fathoms).—McNeill and Livingstone, Records Australian Mus., vol. 15, No. 2, Nov. 18, 1926, p. 194 (off Ellison Reef).

Diagnostic features.—The arms are from 30 to 78, usually about 40 and rarely over 60, in number. The cirri are few in number, irregularly distributed about the periphery of a thin more or less circular, pentagonal or stellate centrodorsal, or confined to the interradial angles. Fully developed cirri have 13–17 (usually 14–15) segments, but some or all of the cirri are more or less undeveloped, and these organs are frequently represented by mere stumps and occasionally absent altogether.

Description.—The centrodorsal varies from a thin circular disk to a very small pentagonal or stellate plate depressed slightly beneath the level of the radials. The cirrus sockets, when present, are arranged in a single more or less deficient marginal row.

The cirri, if present, are I–XV, 14–15, 10 mm. long, moderately slender, similar to those of *C. parvicirra* but proportionately larger.

When no cirri are present the ends of the basal rays are visible as very small tubercles in the interradial angles of the calyx at the angles of the centrodorsal.

The radials are very short, and if cirrus sockets or cirri are present the centrodorsal may be so large as almost entirely to conceal them. The IBr_1 are almost or quite twice as long as the radials, though short, five or six times as broad as long and closely united laterally. The IBr_2 (axillaries) are about twice as long as the IBr_1, from two to three times as broad as long, in lateral apposition or widely free. The IIBr series are 4 (3+4) in the majority of cases, 2 in the minority, rarely all 4 (3+4) or the majority 2. The IIIBr series are 4 (3+4), rarely 2. The IVBr series are 4 (3+4), but the series is more or less deficient. The division series may all be narrow, strongly rounded dorsally and laterally, and widely separated from the IBr_1 onward, or the more proximal division series may be broad and in lateral apposition as far as the $IIBr_1$, becoming more narrow and well separated from that point onward.

The arms are 40–60 in number, from 100 to 195 mm. in length. The first 2 brachials are subequal, slightly wedge-shaped, about twice as broad as the exterior length, the first almost entirely united interiorly, the second interiorly free. The first syzygial pair (composed of brachials 3+4) is oblong, about twice as broad as long. The next 2 or 3 brachials are oblong, from two and one-half to three times as broad as long, and those following become very obliquely wedge-shaped or triangular, from half again to twice as broad as long, and after the proximal third of the arm less oblique, though remaining of about the same proportionate length. From about the second onward the brachials have slightly overlapping distal ends.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 14+15, and distally at intervals of usually 4 muscular articulations.

P_D is from 12.5 to 25 mm. (usually between 17 and 23 mm.) in length, moderately stout basally but tapering rapidly in the proximal third or half and very slender distally, composed of 35–40 segments which have prominent and overlapping distal ends. The terminal comb is made up of 7–8 moderate-sized spatulate teeth which may be provided with spinous borders; some or all of the teeth may be repeated on the inner side of the pinnule. P_P is similar to P_D and only slightly, if at all, shorter and more slender. P_1 is similar to P_P, somewhat shorter and slightly more slender. In a specimen with P_D from 23 to 25 mm. long, P_P is 20 mm. long and P_1 is 17 mm. long. P_2 is small and weak, from 7 to 10 mm. long. P_3 and the following pinnules are of the same length but considerably stouter. The distal pinnules are slender and delicate, 13 or 14 mm. long. The terminal comb disappears after P_1 or P_a. The segments of the lower and middle pinnules have prominent distal ends, and the distal ventrolateral angle is strongly produced; both of these features gradually die away distally, disappearing first from the distal part of the pinnules, then gradually more and more toward the base, and finally altogether.

The color in alcohol is brownish white to dark brown, deep blackish brown, or dark grayish green. Dried specimens are green, olive, or various shades of brown.

Notes.—Chadwick did not distinguish *timorensis* from *parvicirra*. He said the number of arms of the specimens of *parvicirra* collected during the Ceylon pearl-oyster fisheries investigations varied from 10 in a specimen from station XLI and 11 in one from station LVII to 48 in one from station IX. The 10-armed example is a specimen of *Comissia chadwicki*, and the specimens with numerous arms undoubtedly represent this species. He remarked that the specimens with 44 and 48 arms have no spines, or but feebly developed ones, on the penultimate segment of the cirri, and in them the IBr series and the $IIBr_1$ are in close lateral contact. Several IIBr 2 series occur in most of the specimens.

Of the 3 specimens from Galle, Ceylon, 1 has 35 arms 100 mm. long, the IIIBr series being all present on 3 of the rays; 2 are present, developed externally, on the fourth, and 1 is present, developed internally, on the fifth. Another also has 35 arms. The third has 31 arms 75 mm. long.

The specimen recorded as *Antedon*, sp. by Bell had 39 arms and only a few cirri with about 13 segments and the opposing spine obsolete. He noted that the IIBr and IIIBr axillaries are united to the preceding ossicles by syzygy, and the first brachial syzygy is between brachials 3+4, while the second is between brachials 12+13. These characters are sufficient to identify the specimen as *Comanthus annulata*.

Two of the specimens recorded (as *parvicirra*) from Ceylon by Bell in 1887 are in the British Museum. One of these has 43 arms. Seven of the IIBr series are 2 and 3 are 4 (3+4). The IIIBr and subsequent series are all 4 (3+4). There are only very small rudiments of cirri. The other specimen has about 40 arms.

Dr. Hubert Lyman Clark wrote that the 22 specimens from Ceylon that he examined had from 40 to 54 arms. The division series were nearly always 4 (3+4).

One of the specimens from Ceylon in the Museum of Comparative Zoölogy has 47 arms. One of the IIBr series and 2 of the IIIBr series are 2. There are about a dozen nonfunctional cirri, which are mostly small.

Another from Ceylon has 43 arms. Two of the IIBr series are 2. There are VI small nonfunctional cirri.

A third individual has about 40 arms. Three of the IIBr series are 2. The centrodorsal is irregularly pentagonal in shape and bears some rudimentary cirrus sockets.

The other 2 specimens from Ceylon have 40 and 54 arms.

Of the 2 specimens from Tuticorin in the British Museum, 1 has 68 arms; there are IV cirri, one large and the rest diminishing in size, the larger having 13–14 segments. The other has 43 arms and the cirri XV, 14–16.

The specimen from the Indian Ocean (probably the Dutch East Indies) collected by Mr. George Bennett has 33 arms.

The specimen from Port Blair, Andaman Islands, has 34 arms 110 mm. long. All 10 of the IIBr series and 14 IIIBr series are developed, the latter in 1, 2, 2, 1, order, except where there are 4 on a ray. One of the IIIBr series is 2, the others being 4 (3+4).

The specimen from Atjeh was described by Hartlaub as having a medium-sized centrodorsal and 48 arms, with all the division series beyond the IBr series 4 (3+4).

The specimen from the southern portion of the Malacca Straits has 51 arms 140 mm. long. Eleven IVBr series are present. Four of the IIBr series are 2, as are 3 or 4 of the outer division series. There remain 1 cirrus 10 mm. in length with 14 segments, and 3 very rudimentary cirri. This specimen agrees perfectly with the magnificent specimen from Bowen, Queensland, in the Copenhagen Museum.

The specimen from Singapore collected by Mr. Svend Gad has 41 arms 100 mm. long. The IIBr and IIIBr series are all 4 (3+4), and the single IVBr series is 2.

Gislén said that in a specimen from Java, which possibly represents a new species on account of the very long, slender, and well-separated arms, the terminal combs occur on every second pinnule and reach at least to the thirty-fifth, whereas in the specimen from the Bonin Islands they reach only as far as the eleventh pinnule.

The larger specimen from *Siboga* station 322 has 49 arms 130 mm. long. All of the IIIBr series are present. Of the IIBr series, 6 are 2 and 4 are 4 (3+4), the latter all occurring on 2 postradial series. The centrodorsal is greatly reduced, small and sharply stellate. The division series are broad and are in close lateral apposition and sharply flattened against each other. The smaller example has 3 of the postradial series undergoing adolescent autotomy. One partially developed cirrus remains on an irregularly pentagonal centrodorsal.

The example from *Siboga* station 209 has 42 arms 95 mm. long. Five of the IIBr series are 2. There are VII cirri.

The specimen from *Siboga* station 149 has 36 arms 110 mm. long. All the IIBr series are 2. One of the IIIBr series is 2, the others being 4 (3+4). The centrodorsal is greatly reduced, pentalobate, bearing at the tip of one of the lobes a single cirrus 9 mm. long with 14 segments.

Of the 17 specimens from *Siboga* station 89 the largest has 39 arms, of which the anterior are 111 mm. and the posterior are 70 mm. in length. All the division series beyond the IBr series are 4 (3+4). An external IIIBr series is missing. The centrodorsal is small, with the dorsal pole 1.5 mm. in diameter. The cirri are XII, 15, 9 mm. long, somewhat compressed distally.

Another specimen has 28 arms, of which the anterior are 120 mm. and the posterior are 55 mm. in length. The anterior arms are excessively attenuated. The cirri are XII, 12–13, very small and weak, from 6 to 7 mm. long.

A third example has 28 arms, the anterior 90 mm. and the posterior 55 mm. long. Of the IIBr series, 9 are 2 and 1 is 4 (3+4). All of the IIIBr series are 4 (3+4). The cirri are X, with some rudimentary ones in addition, from 8 to 9 mm. long, and distally compressed.

A fourth specimen has 22 arms, of which the anterior are very attenuated and reach 130 mm. in length. Of the IIBr series, 5 are 2 and 5 are 4 (3+4). The IIIBr series are 4 (3+4). Although the arms are much longer, the calyx is the same size as that of the preceding specimen. The cirri are X, 12, 8 mm. long, slender, and arranged in interradial pairs.

Of the remaining specimens, 3 have exactly 40 arms, all of the IIIBr series being present; 4 others have 37, 33, 32, and 25 arms, respectively, 5 are small, and 1 is an 11-armed young.

The example from *Siboga* station 43 has 40 arms which are about 100 mm. long. The IIBr and IIIBr series are all 4 (3+4). The centrodorsal is pentagonal, sunken nearly to the level of the dorsal surface of the radial pentagon, with a few obsolete cirrus sockets on the margin.

The specimen from *Siboga* station 50 has 39 arms 120 mm. in length. The IIBr and IIIBr series are all 4 (3+4). The centrodorsal is pentagonal, very slightly raised above the surface of the radials. A single slender cirrus, 10 mm. long with 14 segments, remains.

Müller described *Alecto timorensis* as follows:

The centrodorsal is very small, slightly over 2.25 mm. in diameter.

The cirri are XVI, 14. A few of the segments toward the base are longer than the others, and their ends are thicker.

The IIBr and IIIBr series are 4 (3+4).

The arms are 36–40 in number, 108 mm. long. The distal intersyzygial interval is usually 4 muscular articulations.

The first pinnule, preceding the first brachial axillary, is three times as long as the second of the same side. From that point on the pinnules are moderately equal.

I examined Müller's types in the Leyden Museum. The cirri are VI, XIII, and XIV, 13–14. These specimens can be exactly matched with others which I have studied from the Philippine Islands.

The 2 specimens from Timor collected by the *Gazelle* each have about 40 arms 80 mm. long. One has one, the other 2, of the IIBr series 2 instead of 4 (3+4). In both, all the remaining division series are 4 (3+4).

The example from *Siboga* station 213 has 40 arms 80 mm. long. One IVBr series is present, and one IIIBr series is lacking. All of the division series beyond the IBr series are 4 (3+4). There are V cirri, and in addition several small stumps.

The specimen from *Siboga* station 273 has 36 arms 100 mm. long. There are II small cirri and several stumps.

The *Challenger* specimen from Banda recorded (as *parvicirra*) by Carpenter has about 40 arms. The centrodorsal is small, entirely without cirri, and is sunken to the level of the dorsal surface of the radial pentagon.

The *Challenger* specimen from Banda in 31 meters was described by Carpenter as a new species under the name of *Actinometra littoralis*. He indicated the characters as follows:

The centrodorsal is a very thin pentagonal disk with the sides slightly concave. Its dorsal surface lies rather above that of the radial pentagon, from which it is separated by faint subradial clefts.

The cirri are all lost.

The radials are visible. The IBr_1 are almost completely united laterally, but the IBr_2 (axillaries) are free. The rays may divide four times. The IIBr and IIIBr series are 4 (3+4). The IVBr series, when present, are 2.

The 38 arms average 100 mm. in length. The anterior arms consist of 150 and the posterior of 100 brachials which are triangular at the base, gradually becoming more quadrate and slightly elongated toward the end. All of the arms are grooved.

Syzygies occur between brachials 3+4 and 11+12 or 12+13, and distally at intervals of 4 or 5 muscular articulations.

P_D reaches 12.5 mm. in length, and the pinnule on the IIIBr series is nearly as long, but P_1 is much shorter. The next pair of pinnules are the smallest, their successors increasing again. The terminal pinnules are much longer and more slender in the anterior than in the posterior arms. The lowest segments of the proximal pinnules are rather wide and overlap slightly, being provided with spinose margins. The proximal pinnules have a well-defined comb which disappears by the fourth or fifth brachial.

The disk is 20 mm. in diameter and is naked. The mouth is interradial.

The color in alcohol is deep blackish brown.

Carpenter remarked that as only one specimen of this species (*littoralis*) was obtained he was unable to state its characters as definitely as he could wish. In the normal arrangement of the arm divisions the IIBr series and the IIIBr series are 4 (3+4), just as in *parvicirra*, but sometimes the IIIBr series are 2, and in one case this arrangement is followed by a IVBr 2 series. He believed that *littoralis* differs from *parvicirra* in the more complete reduction of the centrodorsal. This is not quite lowered to the level of the radial pentagon, from which it is separated by commencing subradial clefts, a condition not reached by any specimen that he had seen which in other respects presented the general characters of *parvicirra*. A minor point of distinction between the two is, according to Carpenter, afforded by the overlap and the very spiny margins of the lower pinnule segments in *littoralis*, while the terminal comb disappears earlier than is usually the case in *parvicirra*, though it is well developed on the proximal pinnules.

His figure shows a typical specimen of *timorensis* with 38 arms and a reduced pentagonal centrodorsal with fairly well developed subradial clefts. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. Of the 17 IIIBr series, 12 are 4 (3+4) and 5 are 2.

I examined his specimen at the British Museum and found it to resemble one from Torres Strait in the United States National Museum.

The specimen collected by the Danish expedition to the Kei Islands at Banda has 42 arms 130 mm. long. Of the 10 IIBr series, 8 are 2 and 2 are 4 (3+4). Of the 18 IIIBr series, 12 are 4 (3+4) and 6 are 2. The 4 IVBr series are 2. The centrodorsal is small, pentagonal with somewhat produced angles, and its dorsal surface is slightly below that of the radial pentagon. One of the specimens from off Neira, Banda, has 32 arms, of which the very attenuated anterior arms reach 130 mm. and the short posterior arms about 60 mm. in length. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. The cirri are III, 10–11, 6 mm. long, small, weak, and slender; in addition there are some very undeveloped cirri. The other specimen also has 32 arms which are 105 mm. long. Six of the IIBr series are 4 (3+4) and 4 are 2. Two of the IIIBr series are 2. The centrodorsal is greatly reduced and stellate.

One of the specimens from Amboina collected by the Danish expedition to the Kei Islands has 35 arms from 80 to 100 mm. long. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. All of the other division series are 4 (3+4). The cirri are II, 13–14, with 2 rudimentary in addition. The other specimen from Amboina has 31 arms 100 mm. long. Nine of the IIBr series are 4 (3+4) and 1 is 2. All the other division series are 4 (3+4). The cirri are IV.

Hartlaub recorded 19 specimens of *parvicirra* from Amboina, all of which seem to belong to this form.

They have a very small centrodorsal which is commonly pentagonal and bears not more than X cirri of about 12 segments. The cirri are short and slender. In 2 specimens they are entirely absent, while in several others only traces of them are present.

The radials are always partially and often wholly visible. The IIBr series are usually both 2 and 4 (3+4) in the same individual, with a strong tendency to the development of IIBr 2 series. Only in 5 specimens are IIBr 2 series entirely absent, while in the remaining 14 one has 7 IIBr 2 series and another has 6.

As a result of the regular development of some, or even of all, of the IIIBr series, the number of arms is always more than 20, and is often more than 30. The length of the anterior arms may reach 170 mm., though generally they are shorter.

The disk is naked.

The color in alcohol is often light brown with a tinge of olive and with the brachial articulations dark, frequently with a dark mediodorsal line on the division series.

The specimen from Batjan has 41 arms which are about 100 mm. long. Three cirri remain attached to the centrodorsal.

One of the specimens from the Danish expedition to the Kei Islands station 30 has 39 arms, of which the anterior become very attentuate distally and reach a length of 180 mm. Of the 10 IIBr series, 7 are 4 (3+4) and 3 are 2. There are 19 IIIBr series, all 4 (3+4). The centrodorsal is very small, 3 mm. in diameter. There are 2 almost fully developed, but slender and delicate, cirri, 1 much smaller, and 2 buds of 1 segment each. The 2 cirri have each 14 segments and are 10 mm. long. Another specimen has 31 arms; of the IIBr series, 7 are 4 (3+4) and 3 are 2. There is a single cirrus with 11 segments. A third example is similar to the last. The fourth specimen has 25 arms, of which the anterior are greatly attentuated and elongated and reach 160 mm. in length, the posterior being 90 mm. in length. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. The centrodorsal is greatly reduced and is rounded pentagonal. There are no cirri, but 2 very small cirrus buds are present.

The specimen from Dobo Strait, Aru Islands, as described by Reichensperger, has 43 arms 95 mm. long. Several of the IIBr series are 2. On one ray a IIBr 2 series is followed by 2 IIIBr 2 series. The cirri are wholly lacking. The color, as preserved, is olive.

The details of the 9 specimens dredged by the *Endeavour* between Fremantle and Geraldton are as follows:

The arms are about 45 in number and are about 110 mm. long. There are VI cirri.

There are 40 arms about 110 mm. long and X cirri.

There are about 40 arms. One of the IIIBr series is 7 (3+4, 6+7). The centrodorsal is a pentagonal plate slightly raised above the dorsal surface of the radial pentagon, with a few obsolete cirrus sockets about its periphery.

There are about 40 arms. The centrodorsal is very thin discoidal, pentagonal in outline. There are III cirri.

There are about 35 arms which are about 110 mm. long.

There are about 35 arms about 90 mm. long. The centrodorsal is greatly reduced. There are III cirri.

There are about 35 arms and VIII cirri. The centrodorsal is greatly reduced.

There are about 30 arms and V cirri.

There are about 25 arms which are about 115 mm. long.

Of these specimens, 2 are uniform light yellowish brown. The other 7 are yellowish brown, darkest on the calyx, division series, and arm bases, where they are thickly covered with small uniform circular green spots. According to the label these were dull green in life.

These specimens agree with those taken by the Hamburg southwest Australia expedition at Shark Bay, and with others which I have examined from the vicinity of Perth.

Dr. H. L. Clark said that in the 7 specimens which he examined from Wooded Isle the number of arms ranged from 36 to 47, and their length varied from 100 to 125 mm.

In the specimen with 36 arms all the division series beyond the IBr series are 4 (3+4), but in the 1 with 47 arms 4 of the IIBr series and 1 of the IVBr series are 2. The cirri are very weak, V–VIII, 12.

Doctor Clark noted that the uniformity of these specimens in coloration is their most notable feature, and in this they agree with 7 of the specimens from between Fremantle and Geraldton, except that they have apparently a darker ground color. But they are all spotted with uniformly small circular greenish-yellow dots, generally quite distinct, but obscured in some of the darkest specimens. Doctor Clark remarked that in view of the extraordinary diversity in color of this species at the Murray Islands, Torres Strait, it is remarkable that no diversity at all is shown at the Abrolhos. He suggested that possibly this western form may be worthy of a varietal name, but further field observations are necessary before a decision can be reached.

One of the specimens presumably from the vicinity of Perth has 41 arms about 90 mm. long. Two of the IIIBr series are 2, but all the other division series beyond the IBr series are 4 (3+4). The centrodorsal is very thin and is irregular in shape. There are XI fully grown and 2 small cirri which are rather irregularly spaced. The fully grown cirri are 7 mm. long and are composed of 13 segments; they appear rather small and weak. P_D is 21 mm. long. The color, including that of the cirri and the dorsal pole of the centrodorsal, is purplish gray, thickly covered with uniform small rounded whitish spots, the outer half of the arms becoming rather suddenly lighter and being unspotted.

A second specimen has 33 arms about 60 mm. long. Five of the IIIBr series are 2, all the other division series beyond the IBr series being 4 (3+4). The centrodorsal is almost completely reduced to the stellate form and bears VII cirri, all but one of which are interradial in position. The color is a uniform purplish black.

A third specimen is in general similar to the preceding. There are 31 arms about 45 mm. long. The centrodorsal bears V cirri, arranged in one pair and one trio, all on the same semicircumference of the centrodorsal. The cirri are 6 mm. long and are composed of 13 segments. The color is a uniform purplish black, but there is a large yellow spot in the center of the centrodorsal.

The fourth specimen is smaller and of a uniform purplish black color, like the 2 preceding.

Of the 9 specimens from the Hamburg southwest Australia expedition station 23 one large individual has 61 arms 120 mm. long and the cirri VI, 8.5 mm. long, confined to the anterior semicircumference of the centrodorsal. All the division series beyond the IBr series are 4 (3+4). The color is dark brown, the division series and arm bases with uniformly distributed small equal-sized light-green spots.

A second specimen has 37 arms 120 mm. long and IV cirri 9 mm. long. All the division series beyond the IBr series are 4 (3+4). The color is the same as that of the preceding.

A third specimen has 34 arms 105 mm. long and the cirri IV, 8 mm. long. It is colored like the preceding.

A fourth specimen has 41 arms 75 mm. long. The cirri are VIII, 14.9 mm. long. There are 3 IIBr series. The coloration is as in those preceding.

A fifth specimen has 26 arms, of which the anterior are 85 mm. long and the posterior are 40 mm. long. The cirri are II, 6 mm. long. Six of the IIBr series are 2, the remaining 4 being 4 (3+4). The color is plain dark brown. The remaining 4 specimens are small.

The specimen from the Hamburg southwest Australian expedition station 26 has 24 arms 105 mm. long. Of the IIBr series, 7 are 2 and 3 are 4 (3+4). Of the 4 IIIBr series present, 2 are 2 and 2 are 4 (3+4). The 2 IIIBr 2 series are single, both internal, and both developed on IIBr 4 (3+4) series. The 2 IIIBr 4 (3+4) series are on a single IIBr 2 series. The centrodorsal is approximately circular, 3 mm. in diameter, and flat, except for a shallow pit in the center. There are VI fully grown cirri and 4 rudimentary cirri of various lengths. The fully grown cirri are 6 mm. long with 13–14 segments. The color is dark brown.

The specimen from *Challenger* station 186 was described by Carpenter as a new species under the name of *Actinometra valida*.

According to him the centrodorsal is a thin circular disk bearing about XV cirri which have some 15 tolerably uniform segments, of which the distal are laterally compressed and carry a faint dorsal spine.

The radials are just visible. The IBr_1 are closely united laterally. The IBr series are broad, and the succeeding IIBr series are in close lateral contact. The IIBr series are 2. The IIIBr and IVBr series are 4 (3+4). The IIBr and IIIBr series and the lower brachials have rather flattened sides.

The 46 arms are probably 110 mm. long. They are composed of subtriangular and somewhat overlapping brachials which become more discoidal toward the middle of the arms and squarer toward the ends. There are 120 brachials in the anterior and 80 in the posterior arms. Several of the arms are ungrooved.

Syzygies occur between brachials 3+4, 11+12, and 16+17, and distally at intervals of 4 or 5 muscular articulations.

The second segments after the IIBr and subsequent axillaries bear long and rather stout pinnules, P_D reaching nearly 25 mm. in length. The pinnule of the fourth brachial (epizygal) is smaller than P_1, but those following are stouter, with rather large segments. The terminal comb is small and is much obscured by perisome.

The disk is 21 mm. in diameter and is naked. The mouth is radial.

Carpenter's figure shows a quite typical specimen of *timorensis*, with rather more cirri than usual. It does not quite agree with the description, for of the 10 IIBr series 4 are 4 (3+4) and only 6 are 2. Furthermore, one of the IIIBr series is 2. I examined this specimen in London.

Dr. H. L. Clark's *Comanthus callipeplum* was described in the following terms:

The centrodorsal is moderate, flat, 5 mm. in diameter.

The cirri are VIII, 15, about 7 mm. long. In addition to these rudimentary cirri, the margin of the centrodorsal has 10 large cirrus sockets. The small cirri taper to a slender tip.

The IIBr series are usually 4 (3+4), but occasionally 2. The IIIBr series are generally 2, but in 1 arm 3 and in 2 arms 4 (3+4). The IVBr series are 4 (3+4) except for 1 which is 2. The IBr and IIBr series are in close contact with their neighbors, and their dorsal surface is smooth and nearly flat.

The 78 arms are about 90 mm. long, and consist of approximately 100 brachials. The outer brachials are more or less overlapping, with finely serrate distal margins.

Syzygies occur between brachials 3+4 and 8+9, and then at intervals of 4 or 5 muscular articulations.

The pinnules on the division series have 35–40 segments, but only those in the terminal fifth are involved in the comb. The lower brachial pinnules are rather short, with 14–16 segments. The distal pinnules are notably longer and more slender, with the same number of segments.

Doctor Clark said that although this species is nearly related to *Comantheria briareus* it is distinguishable by the presence of cirri, the great breadth of the IIBr series, the absence of interradial plating, the frequent syzygies, and the remarkable coloration. In 1918 I placed it in the synonymy of *Comantheria briareus*. But a subsequent examination of the type showed that it is undoubtedly an example of *Comanthus timorensis*.

In 1921 Doctor Clark wrote that in the *Siboga* report I assigned this species to the synonymy of *Comantheria briareus*, in spite of his definite assertion to the contrary. He said that of course, in view of this action, he had again been over the evidence, and he is confident that I am wrong.

He noted that the Museum of Comparative Zoölogy has a fine series of 28 specimens of *briareus* from the Philippines, most of which are accompanied by Doctor Griffin's valuable notes on their color in life. Some of these are rather small, and on one several cirri are present. The presence of cirri in *callipepla* is not in itself, therefore, a character to distinguish the species invariably from *briareus*. Indeed, it is quite possible that the Murray Island species may lack cirri when old, and particularly when senescent.

But comparison of a cirrus of *briareus* with one of *callipepla* brings out another distinguishing character not emphasized in the original description. In *briareus* the cirri when present are composed of about 11 segments and end in a conspicuous curved claw, while in *callipepla* there are 16 segments and the terminal claw is minute and scarcely at all curved. The form of the individual segments in the two species is also seen to be markedly different when the cirri are placed side by side.

Doctor Clark remarked that the difference between *briareus* and *callipepla* in the form of the IBr and IIBr series is very striking, and by itself is ample to separate them.

He said that as for the difference in color, *briareus* is commonly brown of some shade, or very deep reddish; it is often sprinkled, speckled, blotched, or variegated with yellow green or yellow, but in none of the Philippine specimens nor in any recorded cases is there any approach to the green and yellowish-white coloration of *callipepla*.

Doctor Clark continued that since examining the holotype (M. C. Z., 579) I decided that *callipepla* is synonymous with *timorensis*, an opinion in which he can not possibly concur. Among hundreds of *timorensis* seen at Mer the maximum number of arms noted was 47, and the largest number which he has found recorded is 68. Moreover, the coloration of *callipepla* is quite different from that of any of the multitudinous color forms of *timorensis*. Finally, the IIIBr series is 2, not 4 (3+4), and hence by my own system of generic division *callipepla* is a *Comantheria* and not a *Comanthus* at all. He was glad, however, that I am ready to admit that it is not *briareus*.

In his discussion of *timorensis* as he found it at Mer, Dr. H. L. Clark said that one form is so sharply set off from the others that it is entitled to designation by a varietal name and may be called variety *xanthum*. In it the dorsal surface is deep canary yellow, while the pinnules are bright red. He found only 3 specimens with this type of coloration, all near the edge of the reef. He noted that except for their color they were not peculiar. I examined all 3 specimens at Cambridge. As preserved they do not differ in any respect from typical *timorensis*. One has 34 arms, with all the division series beyond the IBr series 4 (3+4), the second is similar, and the third (the holotype, M. C. Z., 569) is young.

Dr. Hubert Lyman Clark reports that as found at Mer the arm length of *timorensis* ranged from less than 25 mm. up to approximately 150 mm. The number of arms ranged from 13 to 47, but the great majority of individuals had between 32 and 43. Only 11 were noted with more than 43 arms. The division series are very generally 4 (3+4), and it is not difficult to find individuals with from 38 to 40 arms in which every division series is 4 (3+4). But on the other hand most individuals have 1 or more of the division series 2, and in 1 specimen no fewer than 13 of the division series are of this number. In 2 specimens, 1 with 40 and 1 with 42 arms, a VBr series is present.

The number of cirri ranges from none, a very common condition, to as many as XVIII or XIX; but as a rule they are few and weak.

Some of the specimens from Mer which I examined at the Museum of Comparative Zoölogy present the following characters:

There are 41 arms, the longest 95 mm. long. All the division series beyond the IBr series are 4 (3+4).

There are 40 arms, of which the anterior are 140 mm. in length. All of the IIBr and IIIBr series are present, and all are 4 (3+4). There are IV cirri.

The 39 arms are 130 mm. long. All of the IIBr series are 2, but 1 of them has a supplementary interpolated ossicle. The 19 IIIBr series present are 4 (3+4). The centrodorsal is regularly stellate with no trace of cirrus sockets, and its dorsal surface is sunken almost to the level of that of the radial pentagon.

A specimen with 38 arms has all the division series beyond the IBr series 4 (3+4).

An example with 37 arms about 135 mm. in length has 1 of the IIBr series 2, all of the other IIBr series and all of the IIIBr series being 4 (3+4).

A specimen with 37 arms 75 mm. long has no cirri.

A specimen with 35 arms 85 mm. long has the cirri VI, 15–16.

An individual with 31 arms has 7 of the IIBr series 2 and 3 of them 4 (3+4); the further division series are all 4 (3+4).

In a specimen with 27 arms about 110 mm. in length all of the division series beyond the IBr series are 4 (3+4).

A specimen with 26 arms also has all the division series beyond the IBr series 4 (3+4).

In an example with 24 arms the 10 IIBr series are all 4 (3+4), and the 4 IIIBr series are all 2.

A young specimen has 13 arms 27 mm. long.

A specimen from Friday Island has about 52 arms which are 130 mm. in length.

A specimen from the Great Barrier Reef is large and stout, with 49 arms 150 mm. long. Two of the IIBr series are 2. The centrodorsal is sunken to the level of the radial pentagon.

The specimen from Cape York which served as the type of *Actinometra annulata* according to Bell presents the following characters:

The centrodorsal is discoidal, flat, with the cirri arranged in a single marginal row.

The cirri are about XV, about 15, 8 mm. long. None of the cirrus segments are much longer than broad, although the third, fourth, and fifth are a little so. The succeeding segments have distinct, though not prominent spines, though they are not always present on all of them.

The radials are visible. The IBr_1 are very broad and are in lateral contact. The IBr_2 are very broad also. The IIBr and IIIBr series are 4 (3+4).

The 40 arms are nearly or quite 100 mm. long. The first brachials are broad and are in contact interiorly. After the sixth the wedge shape of the brachials rapidly becomes apparent, and the segments strongly overlap on either side alternately. The distal edges of the brachials may present delicate denticulations. Some way out the wedge form diminishes, and then, owing to the strong projection of the ridges, the arms appear somewhat as though they were ringed.

Syzygies occur between brachials 3+4, 11+12, and 16+17, and distally at intervals of about 5 muscular articulations.

The pinnule on the IIIBr series is only a very little longer than P_D; both are made up of a large number of small segments. The fourth or fifth pinnule is short and fleshy. Further out the pinnules are longer again, and their segments are elongated and delicate.

The disk is 10 mm. in diameter.

The type material on which the name *annulata* is based consists of 4 specimens. One of these has 40 arms and VIII cirri, these being deficient on a part of the periphery of the centrodorsal. Another has 39 arms and IX cirri, which are absent from a part of the periphery of the centrodorsal. A third has 39 arms and the cirri XII, 16–17. One of the IIBr series is 2, but the other IIBr series and all of the IIIBr series are 4 (3+4). The fourth specimen is broken.

A comparison between the characters of these specimens and Bell's descriptions shows that the third is the one which he must have had chiefly in mind when he wrote the diagnosis, as it is the one which has the cirri nearest the number given by him. It should therefore be considered as the type, and indeed was designated as the type in my memoir on the crinoids of the Indian Ocean (1912).

According to Dr. H. L. Clark, the specimen from Surprise Shoal is small with 21 arms between 40 and 50 mm. in length, and IV cirri.

The specimen recorded by McNeill and Livingstone from off Ellison Reef is juvenile, with the longest arms measuring about 72 mm. The ventral side is dark brown, the dorsal side lighter.

Of the 2 immature specimens from Port Denison in the Australian Museum, 1 has 19 arms about 100 mm. in length, and the other has 24 arms about 120 mm. long. In both the centrodorsal is much reduced in size.

In the specimen from Bowen in the Copenhagen Museum the centrodorsal is a very thin pentagonal plate which is scarcely raised above the dorsal surface of the radial pentagon. Three of the basal segments of a single cirrus remain.

The division series are broad and are in close lateral apposition to and including the $IIBr_1$, but are well separated from that point onward. The IIBr series, IIIBr series, and IVBr series, of which last 5 are present, are 4 (3+4) except for a single IIBr series and 3 IIIBr series, which are 2.

The 45 arms are 195 mm. long. The brachials are short triangular or wedge-shaped, over twice as broad as long, with everted distal ends.

The lower pinnules are not especially long or stout. P_D is from 23 to 25 mm. in length and is composed of about 60 segments. The pinnule on the IIIBr series is 20 mm. long. P_1 is 17 mm. long. P_2 is 10 mm. long.

The color in alcohol is dark brown.

Regarding his *Actinometra meyeri*, the type of which is a dry specimen from "Australia" in the Hamburg Museum, Carpenter says that it is a rather large species distinguished by the thin centrodorsal and the small number of cirri which it bears. The rays divide three times, each division being 4 (3+4). The brachials are triangular and overlap rather markedly. The lowest pinnules appear to have been long and slender, but he noted that in the dry specimen it is difficult to make out their relative proportions, a point of much importance for specific determinations.

Carpenter added that the museums at Dresden and Vienna contain some individuals in alcohol which are probably identical with the dry Hamburg specimen, so far as he could judge from his notes without having made a direct comparison, and he preferred, therefore, to reserve a detailed description of the type until he had made a closer examination of the alcoholic specimens.

The specimen from Friedrich-Wilhelms-Haven is large, with 40 arms. The centrodorsal is much reduced.

The three specimens from St. Matthias Island have each about 40 arms, and the centrodorsal much reduced. All three of them have nearly all of the division series 2 instead of 4 (3+4).

The specimen in the Copenhagen Museum from the Tonga Islands has 34 arms and VI cirri. All of the division series beyond the IBr series are 4 (3+4).

A specimen which I examined in the Hamburg Museum labeled Tonga and Fiji has 44 arms. This is the one with 44 arms recorded by Hartlaub from Tonga. Another from Tonga in the Hamburg Museum recorded by Hartlaub has a moderately large centrodorsal bearing about XXX cirri, and 39 arms. All of the IIBr series are 2.

The specimen from *Challenger* station 174 has about 40 arms. The centrodorsal is stellate with rudimentary cirrus stumps.

The specimen from Fiji in the Hamburg Museum is typical, with 40 arms, all the IIIBr series being present. It is the same size as that from Bowen, Queensland, which was described as *Comanthus intricata.*

The specimen from Fiji in the Copenhagen Museum has 38 arms and XII cirri.

The specimen from Mortlock Island recorded by Hartlaub has 38 arms. Six of the IIBr series are 2.

One of the specimens collected by Dr. Th. Mortensen on a coral reef off Jolo has 32 arms up to 110 mm. long. Of the 10 IIBr series 6 are 4 (3+4) and 4 are 2, the latter being on 2 postradial series, 2 on each. Subsequent division series are all 4 (3+4). The centrodorsal is pentagonal, only very slightly raised above the dorsal surface of the radial pentagon. There is a single weak cirrus. The other specimen is similar, but has V small weak cirri and some additional which are very immature. The example from about 27 meters has 38 arms. All of the IIBr series are present, and all are 4 (3+4). One of the IIBr axillaries bears 2 undivided arms. There are 18 IIIBr 4 (3+4) series. The 2 specimens from about 36 meters each have about 40 arms.

One of the specimens from Bantayan reef, Cebu, has 40 arms which are about 150 mm. long.

In 28 fully developed specimens from Port Galera, Mindoro, which were examined in detail, the number of arms varied from 30 to 53, averaging 41. Of these 28 specimens, 16 had exactly 40 arms. The length of the arms varied from 140 to 280 mm., averaging 193 mm. A small specimen from the same locality has 25 arms 55 mm. long.

One of the specimens collected by Dr. Th. Mortensen at Port Galera, Mindoro, has 40 slender and attenuated arms. Of the 10 IIBr series 6 are 4 (3+4) and 4 are 2. The cirri are IX, 14–16, 9 mm. long, small, slender, and weak. A second specimen has 36 arms, the greatly attenuated anterior arms reaching 150 mm. in length. The 10 IIBr series are all 4 (3+4). Of the 16 IIIBr series 15 are 2 and only 1 is 4 (3+4). There is a single rudimentary cirrus 5 mm. long and a few cirrus stumps. In spite of the very large number of IIIBr 2 series this specimen can not represent a species of *Comantheria* as it lacks all the other characteristics of species of that genus. Another specimen has 34 slender and elongated arms. Of the 10 IIBr series, 7 are 4 (3+4) and 3 are 2. The cirri are V, 15, from 10 to 12 mm. long, slender and delicate. The fourth specimen has 29 arms of which the slender and attenuated anterior are 150 mm. and the posterior are 70 mm. long. Of the 10 IIBr series, 6 are 4 (3+4) and 4 are 2. The cirri are X, all more or less rudimentary.

Carpenter's variety 3 of *Actinometra polymorpha* from Bohol was characterized as follows:

The centrodorsal is large and thick, with only 3 cirrus scars.

The IBr$_1$ are completely united all around the calyx.

The arms are 39 in number.

The intersyzygial interval varies from 2 to 8 muscular articulations, being usually 4.

Combs occur on the pinnules of the division series and of the first 2 brachials, occasionally also on the pinnules of the third, fourth, and fifth brachials.

The color is reddish brown, the center of the dorsal surface of the skeleton from the centrodorsal to near the end of the arms being marked by a faint white line with dark borders.

Carpenter said further that of the 10 IIBr series present, 8 are 4 (3+4) and 2 are 2. There are 19 IIIBr series of which 15 are 4 (3+4) and 4 are 2. Following IIBr 2 series there are 2 IIIBr 2 series and 1 IIIBr 4 (3+4) series, and following IIBr 4 (3+4) series there are 14 IIIBr 4 (3+4) series and a IIIBr 2 series.

In this specimen the first arm syzygy is always between brachials 3+4, but the position of the subsequent syzygies is subject to considerable variation. The following irregular distribution of the first 3 syzygies occurs. Between brachials 3+4, 5+6, 11+12 (once); between brachials 3+4, 5+6, 12+13 (once); between brachials 3+4, 8+9, 13+14 (twice); between brachials 3+4, 9+10, 14+15 (twice); between brachials 3+4, 10+11, 15+16 (seven times); between brachials 3+4, 11+12, 15+16 (four times); between brachials 3+4, 11+12, 16+17 (sixteen times); between brachials 3+4, 11+12, 17+18 (once); between brachials 3+4, 11+12, 19+20 (once); between brachials 3+4, 12+13, 17+18 (three times).

The number of muscular articulations in the first intersyzygial interval in 38 arms of this specimen is given by Carpenter as follows: 1 (twice); 4 (twice); 5 (twice); 6 (seven times); 7 (twenty-two times); 8 (three times).

The number of muscular articulations in the second intersyzygial interval in 38 arms of this individual is given by Carpenter as follows: 3 (four times); 4 (thirty times); 5 (twice); 6 (once); 7 (once).

In the distal intersyzygial interval there is a tendency to a decrease rather than to an increase in the number of muscular articulations, which is more often 3 than 5.

Carpenter's variety 4 from Ubay was thus characterized.

The centrodorsal is large and thick, with only 3 cirrus scars.

The IBr_1 are closely united all around the calyx.

The arms are 33 in number, all tentaculiferous, and tolerably uniform in length and in the character of their pinnules.

The intersyzygial interval varies from 1 to 7 muscular articulations, being usually 4.

The oral pinnules are much stouter than in the type (by which apparently is meant variety 1 from Ubay, herein described under *parvicirra*). That of the third brachial is but little shorter than that of the second. The comb is limited to these, and to the pinnules of the division series, and the processes forming it gradually come to rise from the ventral surfaces of the calcareous segments instead of from their outer margins.

The color is blackish brown with a very marked median white line on the dorsal surface of the skeleton.

Carpenter said further that of the 10 IIBr series present 9 are 4 (3+4) and 1 is 2. There are 13 IIIBr series of which 12 are 4 (3+4) and 1 is 2. The single IIIBr series following a IIBr 2 series is 4 (3+4). Of the IIIBr series following IIBr 4 (3+4) series, 11 are 4 (3+4) and 1 is 2.

All of the arms are grooved.

This specimen shows considerable variation in the position of the brachial syzygies. On no less than 10 arms the first syzygy is not between brachials 3+4. On these arms the position of the first 3 syzygies is as follows: Between brachials 4+5, 10+11, 15+16 (once); between brachials 4+5, 11+12, 16+17 (twice); between brachials 6+7, 11+12, 16+17 (once); between brachials 9+10, 14+15, 19+20 (twice); between brachials 10+11, 15+16, 18+19 (once); between brachials 10+11, 15+16, 20+21 (twice); between brachials 10+11, 15+16, 21+22 (once).

On the arms in which the first syzygy is between brachials 3+4 the syzygies are also distributed irregularly in the following cases: Between brachials 3+4, 9+10, 14+15 (twice); between brachials 3+4, 10+11, 15+16 (three times); between brachials 3+4, 11+12, 16+17 (thirteen times); between brachials 3+4, 11+12, 18+19 (once); between brachials 3+4, 12+13, 16+17 (once); between brachials 3+4, 12+13, 17+18 (twice); between brachials 3+4, 14+15, 19+20 (once).

The number of muscular articulations in the first intersyzygial interval in 23 arms of this specimen is given by Carpenter as follows: 5 (twice), 6 (three times), 7 (fourteen times), 8 (three times), and 10 (once).

The number of muscular articulations in the second intersyzygial interval is given as follows: 3 (once), 4 (twenty-one times), and 6 (once).

In the distal intersyzygial interval there is a tendency to an increase rather than to a decrease in the number of muscular articulations, 5 occurring much more commonly than 3.

Carpenter noted that the oral pinnules differ considerably from those of typical *polymorpha*. Not only are they much stouter, but their terminal combs are differently constituted. The lower processes gradually develop from the outer margin of the ventral surface of each calcareous segment, but toward the end of the pinnule they gradually come to rise less and less from the outer margin and more and more from the median portion of the ventral surface of each segment until finally, on the last 2 or 3 segments, they are developed from the inner margin. Consequently the comb, when viewed from above, is seen not to lie altogether on the outer side of the pinnule as is usually the case, but to start from the outer side, cross its ventral surface, and finally come to lie on the inner side of each pinnule; that is, on the side nearest the arm.

Carpenter in 1882 mentioned having seen in the Dresden Museum some fine individuals of the form which he described as *meyeri* which had been collected in the Philippines by Dr. A. B. Meyer.

In the specimen from the Bonin Islands recorded by Gislén the centrodorsal is flattened and is 4 mm. in diameter. The cirri are arranged in a single marginal row. The dorsal pole of the centrodorsal is 3 mm. across.

The cirri are XV, 15, 9 or 10 mm. long. The first and second segments are broader than long, the third is about as long as broad, and the fourth and following are longer, slightly constricted centrally, the sixth being the longest, half again as long as broad.

The distal segments are one-third again as broad as long. From the seventh or eighth onward a weak and indistinct dorsal prominence is developed. In their distal portion the cirri are somewhat compressed laterally and in a lateral view appear to broaden slightly. The terminal claw is short, stout, and a little longer than the penultimate segment. The cirri are relatively small and weak.

The radials project somewhat at the interradial angles. The IBr_1 are in lateral contact. They are wider distally than proximally, and are five times as broad as long. The IBr_2 (axillaries) are low pentagonal, three times as broad as long, laterally in contact with their neighbors. The IIBr and IIIBr series are 4 (3+4). The first segments following each axillary are interiorly united. The division series and arm bases are smooth and close together.

The 40 arms are from 80 to 120 mm. long. The posterior arms are shorter and stouter than the anterior, and their pinnules often lack ambulacral grooves. The first 7 brachials are oblong, and those following have oblique ends. The outer brachials have the distal ends slightly thickened. There are 14 brachials for each 10 mm. of arm length, or 11 if the syzygial pairs are counted as units. The width of the arms proximally is 2.5 mm. and distally 1 mm. or less.

Syzygies occur between brachials 3+4, 11+12, 16+17, etc., and distally at intervals of 4 muscular articulations.

P_D is from 16 to 18 mm. long, and is composed of about 50 segments of which the terminal 6–8 bear teeth. The pinnule on the IIIBr series is 12 mm. long with 45 segments of which the last 5–6 bear teeth. P_1 is 10 mm. long with about 35 segments of which 7 bear teeth. P_2 is 6 mm. long with about 20 segments of which 7 bear teeth, or the comb may be lacking. P_3 may or may not bear a comb. Beyond P_3 combs occur on every second or third pinnule as far as P_{11}. The distal pinnules are 8 mm. long with about 20 segments of which the first and second are short and the remainder are longer than broad, and the last 4 or 5 bear dorsal hooks. The bases of the pinnules are rather smooth.

The disk is 20 mm. in diameter. The mouth is interradial, and the anal tube is central.

The color in alcohol is grayish brown.

The specimen without locality in the British Museum has 44 arms and the cirri IV, 16–17.

Abnormal specimens.—In one of the specimens from between Fremantle and Geraldton, Western Australia, one of the IIIBr series is 7 (3+4, 6+7).

In the specimen described by Dr. H. L. Clark as *Comanthus callipeplum* the IIIBr series "in one arm" are 3.

In a specimen from Mer (M. C. Z., 530) with all the IIBr series 2 one of these has interpolated between the 2 elements an ossicle which in dorsal view appears irregularly elliptical, reaching not quite to the lateral border on either side. It seems to be united to the preceding and succeeding ossicles by syzygy.

In a specimen from Port Galera, Mindoro (M. C. Z., 667), one of the IBr axillaries is divided by a suture line running from the middle of its proximal border upward and to the right. The portion to the left of this line is an axillary bearing 2 perfect IIBr 2 series and 4 arms. The portion to the right of the line bears an axillary which to the left truncates the corner of the left-hand axillary and is supported by the entire side of the $IIBr_1$. This axillary also bears 2 perfect IIBr 2 series and 4 arms.

Localities.—Ceylon Pearl Oyster Fisheries station XLVI; western coast of Ceylon; from off Mount Lavinia northward to off Colombo, from 7 to 12 miles off shore; 46–55 meters; bottom, nullipore balls (*Lithothamnion fruticulosum*), coral fragments, and some *Orbitolites* sand [Chadwick, 1904; A. H. Clark, 1911, 1912].

Ceylon Pearl Oyster Fisheries station LXIII; Gulf of Manaar; to the west of Periya Paar, going south; 31–100 meters; bottom, *Orbitolites* sand, some dead coral, shells, and pieces of nullipore [Chadwick, 1904; A. H. Clark, 1911, 1912].

Ceylon Pearl Oyster Fisheries station LXIX; western coast of Ceylon; on and to the east of the north end of Chilaw Paar; 15–20 meters; bottom yellow quartz sand, with some coral fragments; yellow algae with oyster spat [Chadwick, 1904; A. H. Clark, 1911, 1912].

Ceylon Pearl Oyster Fisheries station IX; Gulf of Manaar; on the southwestern corner of West Cheval Paar, about 12 miles from land; 13 meters; bottom, fine quartz gravel, nullipore concretions, and many dead young pearl oyster shells [Chadwick, 1904; A. H. Clark, 1911, 1912].

Ceylon Pearl Oyster Fisheries station LVII; Gulf of Manaar; outside Dutch Moderagam Paar; 21–66 meters; bottom, *Orbitolites* sand, nullipores, and dead corals [Chadwick, 1904; A. H. Clark, 1911, 1912].

Ceylon Pearl Oyster Fisheries station LIV; Gulf of Manaar, south of Adam's Bridge; 7–73 meters; bottom varied, from sand to living coral [Chadwick, 1904; A. H. Clark, 1911, 1912].

Investigator; Galle, Ceylon [A. H. Clark, 1912] (3, I. M.).

Ceylon [Bell, 1882; Walther, 1885; A. H. Clark, 1911, 1912]. Same [Bell, 1887; A. H. Clark, 1911, 1912, 1913] (2, B. M.). Same [H. L. Clark, 1915] (5, M. C. Z., 601, 609).

Tuticorin, Madras [Bell, 1888; Thurston, 1894; A. H. Clark, 1911, 1912, 1913] (2, B. M.).

East Indies; George Bennett [P. H. Carpenter, 1881; A. H. Clark, 1911 (as Indian Ocean)] (1, L. M.).

Investigator; Port Blair, Andaman Islands [A. H. Clark, 1912] (1, U.S.N.M., 35084).

Atjeh, Sumatra; W. Baerts, 1887 [Hartlaub, 1891; Horst, in A. H. Clark, 1911; A. H. Clark, 1911, 1912 (as Atjeh, Burma)] (1, L. M.).

Southern portion of Malacca Straits [A. H. Clark, 1912] (1, U.S.N.M., 35085).

Singapore; Svend Gad [A. H. Clark, 1909] (1, C. M.).

Java [Gislén, 1922].

Siboga station 322; southern coast of Bawean Island, 1.5 miles south of Tandjong Lajar; 32 meters; fine gray mud and coral; February 24, 1900 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 209; anchorage off the south point of Kabaëna Island; reef; September 23, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 149; Fau anchorage and lagoon, western coast of Gebé Island; 31 meters; coral bottom; July 10–11, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 89; Pulu Kaniungan ketjil; shore exploration; 11 meters; coral bottom; June 21, 1899 [A. H. Clark, 1918] (17, U.S.N.M., E. 482; Amsterdam Mus.).

Siboga station 43; anchorage off Pulu Sarassa, Postillon Islands; down to 36 meters; coral bottom; April 4–5, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 50; Bay of Badjo, western coast of Flores; down to 40 meters; mud, sand, or shells, according to locality; April 16–18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Timor; Heinrich Boie and Salomon Müller [J. Müller, 1841, 1843, 1849; Dujardin and Hupé, 1862; P. H. Carpenter, 1879; A. H. Clark, 1911, 1912] (3, L. M.).

Gazelle; Timor [A. H. Clark, 1909] (2, Berl. M.).

Siboga station 213; Saleyer anchorage and surroundings, including Pulu Posi Tanette, near the north point of Saleyer; down to 36 meters; coral reefs, mud, and mud with sand; September 26–October 26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands; pearl banks; 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger; Banda [P. H. Carpenter, 1888; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Challenger; Banda; 31 meters [P. H. Carpenter, 1888; A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Banda; June 14, 1922 (1) [Pl. 76, fig. 205]; off Neira, Banda; about 15 meters; sand; June 9, 1922 (2).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Amboina; 1–2 meters; coral; February 12, 1922 (2). Pl. 77, fig. 207.

Amboina; Dr. J. Brock, 1884–85 [Hartlaub, 1891].

Amboina [Döderlein, 1898].

Batjan; Prof. E. von Martens [A. H. Clark, 1912; Hartmeyer, 1916] (1, Berl. M., 1351).

Ternate [Pfeffer, 1900; A. H. Clark, 1911, 1912] (1, H. M.).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 30; about 40 meters; sand and shells; April 18, 1922 (4). Pl. 77, fig. 206.

Aru Islands; Dobo Strait; 50 meters; Dr. H. Merton, March 20, 1908 [Reichensperger, 1913].

Endeavour; between Fremantle and Geraldton, Western Australia [A. H. Clark, 1914; H. L. Clark, 1923] (9, U.S.N.M., 35027; W. A. M.).

Wooded Isle, Abrolhos Islands (Houtman's Rocks), Western Australia [H. L. Clark, 1923].

Hamburg southwest Australia expedition, 1905; ?vicinity of Perth, Western Australia [A. H. Clark, 1911, 1914] (4, Berl. M.).

Hamburg southwest Australia expedition station 23; South Passage, Shark Bay, Western Australia; 9 meters; June 16, 1905 [A. H. Clark, 1911, 1912] (9, H. M.).

Hamburg southwest Australia expedition station 26; Sunday Island, Shark Bay; 5.5 meters; bottom rocky, with coral; June 17, 1905 [A. H. Clark, 1911] (1, Berl. M.).

Western Australia [A. H. Clark, 1912; Hartmeyer, 1916]. This refers to Hamberg southwest Australia expedition station 26, and ?vicinity of Perth (5, Berl. M., 5957, 6135).

Holothuria Bank; 62 meters [A. H. Clark, 1911, 1912, 1913] (2, B. M.).

Northwestern Australia [A. H. Clark, 1911, 1912]. This refers to the locality just preceding.

Challenger station 186; Prince of Wales Channel, Torres Strait (lat. 10° 30′ S., long. 142° 18′ E.); 15 meters; coral mud; September 8, 1874 [P. H. Carpenter, 1888; Hamann, 1889; A. H. Clark, 1911 (as Torres Strait), 1912, 1913; H. L. Clark, 1921] (1, B. M.).

Friday Island, Torres Strait; H. L. Clark, September 13, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 573).

Mer, Murray Islands, Torres Strait; southwestern reef; on staghorn coral; John Mills, October 1, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 579).

Mer, Murray Islands; southwest reef; H. L. Clark, October 14, 1913 [H. L. Clark, 1915, 1921] (2, M. C. Z., 535).

Mer, Murray Islands; H. L. Clark, October 14, 1913 [H. L. Clark, 1915, 1921] (1+, M. C. Z., 528, 577).

Mer, Murray Islands; southeastern reef; H. L. Clark, October, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 524).

Mer, Murray Islands; H. L. Clark, October, 1913 [H. L. Clark, 1915, 1921] (123, M. C. Z., 522, 523, 525–527, 532–534, 550, 555, 568–572, 574–576).

Mer, Murray Islands; H. L. Clark, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 530).

Great Barrier Reef, 4 miles eastnortheast of Mer, Murray Islands; H. L. Clark, October 15, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 529).

Torres Straits [A. H. Clark, 1911, 1912] (2, U.S.N.M., 36165). Pl. 75, fig. 204.

Thursday Island [A. H. Clark, 1912].

Cape York [Bell, 1882; P. H. Carpenter, 1883, 1888; A. H. Clark, 1911, 1912, 1913] (4, B. M.).

Northeastern Australia; Prof. J. Beete Jukes; H. M. S. *Fly*, 1843–1847 [A. H. Clark, 1911, 1913] (1, B. M.).

Off Ellison Reef, outer Great Barrier Reef; between 9 and 27 meters; Surg. Lieut. Comdr. W. E. J. Paradice, R. A. N.; H. M. S. *Geranium*, August, 1924 [McNeill and Livingstone, 1926].

Surprise Shoal, outer Great Barrier Reef (about 18° S.); 13 meters; Surg. Lieut. Comdr. W. E. J. Paradice, R. A. N.; H. M. S. *Geranium*, 1924 [H. L. Clark, 1926].

Port Denison, Queensland [Lütken, 1877; A. H. Clark, 1911]. Same [A. H. Clark, 1911] (2, Austr. M.).

Bowen, Queensland [A. H. Clark, 1908, 1909, 1911, 1912] (1, C. M.).

Australia [P. H. Carpenter, 1882, 1883; A. H. Clark, 1911, 1912] (1, H. M.).

Friedrich-Wilhelms-Haven, New Guinea; Herr H. Schöde [A. H. Clark, 1911, 1912; Hartmeyer, 1916] (1, Berl. M., 5943).

St. Matthias Island, Bismarck Archipelago; Herr H. Schöde [A. H. Clark, 1911, 1912; Hartmeyer, 1916] (3, Berl. M., 5940).

Solomon Islands; H. M. S. *Penguin* [A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Tonga [Lütken, 1874, 1877; von Graff, 1884; Hartlaub, 1891; A. H. Clark, 1909, 1911, 1912] (1, C. M.). Pl. 64, fig. 181.

Tonga and Fiji [Hartlaub, 1891; A. H. Clark, 1911, 1912] (1, H. M.).

Challenger station 174, B, C, or D; near Kandavu, Fiji (lat. about 19° 06′ S., long. about 178° 18′ E.); 411, 1,115, or 385 meters; August 3, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913] (1, B. M.). The specimen could not have come from any of the depths mentioned, but was probably taken in shore collecting.

Fiji [Lütken, 1874, 1877; Hartlaub, 1891; A. H. Clark, 1909, 1911, 1912] (2, C. M.; H M.).

Mortlock Island, Carolines [Hartlaub, 1891; A. H. Clark, 1912].

Albatross; Tulayan Island, Jolo (Sulu) Archipelago, Philippines; shore; September 15, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35082).

Albatross; Babuan Island, Jolo Archipelago; shore; February 14, 1908 (1, U.S.N.M., 36026).

Sulu [A. H. Clark, 1912]. This refers to the 2 preceding localities.

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo; coral reef; March 20, 1914 (2); about 27 meters; March 21, 1914 (1); about 36 meters; March 21, 1914 (2).

Albatross station 5599; off Zamboanga, Mindanao; Zamboanga Light bearing N. 31° W., 0.1 mile distant (lat. 6° 54′ 00″ N., long. 122° 04′ 30″ E.); 16.4 meters; October 12, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35067).

Bantayan reef, Cebu, Philippines; Dr. Laurence E. Griffin [H. L. Clark, 1921] (2, M. C. Z., 380, 383).

Cebu [A. H. Clark, 1912].

Port Galera, Mindoro, Philippines; Dr. Laurence E. Griffin [H. L. Clark, 1921] (65, M. C. Z., 616, 617, 624, 665–668).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; Port Galera, Mindoro; February 3, 1914 (4).

Philippines [H. L. Clark, 1921]. This refers to the specimens from Mindoro and Cebu collected by Doctor Griffin.

Philippine Islands [A. H. Clark, 1911, 1912]. This refers to the specimens collected by the *Albatross*.

Bohol and Ubay, Philippines; Prof. Carl Semper [P. H. Carpenter, 1879, 1888].

Philippine Islands; Dr. A. B. Meyer [P. H. Carpenter, 1882].

Macclesfield Bank [A. H. Clark, 1912].

Albatross station 5321; China Sea, in the vicinity of Formosa (Taiwan); Ibugos Island (S. end) bearing S. 89° W., 1.25 miles distant (lat. 20° 19′ 30″ N., long. 121° 51′ 15″ E.); 46 meters; white sand, coral, and broken shells; November 9, 1908 [A. H. Clark, 1911] (1, U.S.N.M., 35087).

Dr. Sixten Bock's expedition to Japan station 42A; Bonin Islands, west of Port Lloyd; 128 meters; July 31, 1914 [Gislén, 1922]. The depth as given represents the length of line out, not the actual depth.

Pacific Ocean; United States Exploring Expedition (1 +, U.S.N.M., 2702; M. C. Z., 29).

No locality [A. H. Clark, 1913] (1, B. M.).

Geographical range.—From Ceylon and southern India to Australia, south to between Fremantle and Geraldton on the west and Bowen on the east, eastward to Tonga and Fiji and northward to the Bonin Islands, the Philippines, and Formosa (Taiwan).

Bathymetrical range.—From the shore line down to 73 (?100) meters. The average of 23 depth records is 30.7 meters.

Occurrence.—Dr. Hubert Lyman Clark says that this is decidedly the most noticeable comatulid of Mer, and probably of the Torres Strait region. While it is perhaps no more abundant than *Comatula purpurea*, it is much more conspicuous from its more brilliant color as well as from its larger size. It is obviously *the* feature of the animal life on the reefs where conditions are suitable. While it was not uncommon on the southeastern reef at Mer, the southwestern reef was the best place for it.

The diversity of colors shown is really extraordinary, and it is doubtful if anything more beautiful can be found in the sea than a selected group of these exquisite comatulids. A dozen assorted specimens in a large white basin of sea water rival in beauty of texture and form, as well as of color, the finest bouquet a florist can produce.

When seen thus, the appropriateness of the name "sea lilies" is obvious.

It is surprising how little correlation between size (and age?) and color specimens of *timorensis* show. Some of the smallest specimens were very dark olive or dark brown, nearly or quite black, rarely they were red. Specimens from 50 to 75 mm. across were often light brown, yellowish, greenish, or even blue. Larger specimens were commonly brown, olive, green, or purplish. Big specimens were often very dark, and occasionally almost dead black. Few individuals were unicolor. The change of shade, or even of color, between the base and the tip of the arm was usually marked.

The diversity of size, arm number, and number of cirri is no less noteworthy. Doctor Clark's observations on these features are given under "Notes."

History.—This common and handsome species was first described by Johannes Müller in 1841 under the name of *Alecto timorensis*. His description was based upon notes taken by Troschel on some specimens which he found in the Leyden Museum bearing the manuscript name *Comatula timorensis* which had been collected in Timor by Heinrich Boie and Salomon Müller.

Müller redescribed the species in 1849 under the name of *Comatula timorensis*, and in 1862 Dujardin and Hupé published a translation of Müller's original description (1841), also calling it *Comatula timorensis*.

Prof. C. F. Lütken in 1874 mentioned *Actinometra intricata* from Tonga and Fiji in one of the catalogues of the Godeffroy Museum, in 1877 adding Port Denison to the list of localities. The name appears alone, with no indication whatever of the characters of the new form.

In 1879 Dr. P. H. Carpenter described in great detail a new comasterid which he called *Actinometra polymorpha*. The description was based upon 8 specimens which he considered as typical, and 4 others which he regarded as representing varieties. The 8 typical specimens and varieties 1 and 2 represent *parvicirra* as here understood, but varieties 3 and 4 represent the present form.

Carpenter had not been able to examine Müller's *timorensis* at that time, and therefore was unable to assign it either to *Antedon* or to *Actinometra*.

In the same memoir Carpenter said that in three species of *Actinometra* from the *Challenger* collection the anterior arms are longest, although all the arms, anterior and posterior alike, are grooved and bear tentacles. He does not again refer to this statement, and he never identified the species to which he referred. One of them, however, he subsequently described under the name of *Actinometra littoralis*.

In September, 1882, Prof. Jeffrey Bell recorded a specimen of this species from Ceylon under the name of *Antedon*, sp. He remarked that it was the first indication within his knowledge of a comatulid from Ceylon. But *Heterometra reynaudii* was described from Ceylon in 1846 by Johannes Müller, and in 1849 *Capillaster multiradiata* was also recorded from Ceylon by the same author.

On September 26, 1882, Dr. P. H. Carpenter, under the heading *Actinometra meyeri*, n. sp., gave very briefly the characters of a dry specimen from Australia in the Hamburg Museum, intending later to describe the species represented in detail from alcoholic material. He mentioned some conspecific specimens in the museums at Dresden and Vienna, and also some fine individuals which had been collected during his residence in the Philippines by Dr. A. B. Meyer, the director of the Dresden Museum, for whom the species was named.

In October, 1882, Professor Bell described *Actinometra annulata* from a specimen from Cape York in the British Museum. His description was accompanied by an excellent and readily recognizable figure.

In 1883 Carpenter gave a specific formula for his *Actinometra meyeri*, and an emended specific formula for Bell's *Actinometra annulata*.

In 1884 Prof. Ludwig von Graff described some myzostomes which he had found on one of the specimens from the Tonga Islands which had been distributed by the Godeffroy Museum under Lütken's manuscript name *Actinometra intricata*.

Carpenter had now definitely decided that his *Actinometra polymorpha* is identical with Müller's *Alecto parvicirra*, and in the *Challenger* report on the stalked crinoids published in 1884 he used the name *parvicirra* only. He gave the number of arms in *parvicirra* as from 13 to 39 (p. 283), whereby it is evident that he included all of the specimens which in 1879 he had described under the 4 varieties of *polymorpha*. But all of the other references to *parvicirra* appear to cover only *parvicirra* as herein understood.

In the *Challenger* report on the comatulids published in 1888, Carpenter described as a new species *Actinometra valida*. He remarked that the only specimen secured was a fine individual which is allied to Lütken's manuscript species *Actinometra trachygaster* and *Actinometra intricata* from Fiji, Tonga, and Samoa. He noted that it is much larger than *rotalaria*, having an additional axillary and also larger and more numerous cirri, while the division series are broad and generally in close lateral contact, the sides of their proximal segments being somewhat flattened.

In this connection it should be remembered that Carpenter's interpretation of Lamarck's *Comatula rotalaria* was based upon a specimen labeled *Comatula brevicirra* Troschel, which has been collected by Péron and Lesueur in 1803 and which he examined in the Paris Museum in 1876. This he took to be Lamarck's type. It is in reality, however, an example of *Comanthus parvicirra*. Carpenter, unfortunately, overlooked the 2 specimens upon which Lamarck's and Müller's descriptions of *rotalaria* were based.

Carpenter described *valida* as having the IIBr series 2 (see under Notes, p. 613) and made it the type of a special group of species of *Actinometra* which he called the *Valida* group, characterized by having the IIBr series 2 and the first arm syzygy between brachials 3+4.

Another specimen from Banda he described under the name of *Actinometra littoralis*, placing it in the *Parvicirra* group, which was characterized by having the IIBr series 4 (3+4), a pinnule on the second brachial, and a syzygy between brachials 3+4.

Other specimens of this species he included under *Actinometra parvicirra*, which, according to his description, has the arms from 13 to 44 in number. In the synonymy of *parvicirra* he included *Actinometra* (*Comatula*) *armata*, *Actinometra polymorpha*, *Actinometra meyeri*, and *Actinometra annulata*, names which refer wholly or in part to the present species.

Dr. Clemens Hartlaub in 1891 followed Carpenter in uniting this species with *parvicirra*, under which name, like Carpenter, he also included *samoana*. This last, however, he differentiated as Typus A, while *parvicirra* and *timorensis* he grouped together as Typus B. He recorded and gave notes upon 19 specimens of *timorensis* which had been collected by Dr. J. Brock at Amboina, and upon one from Mortlock Island, 1 from Lombock Strait, 2 from Tonga (labeled *Actinometra intricata* Lütken), and 1 from Fiji (labeled *Actinometra guttata* Lütken) in the Hamburg Museum, and also on 1 from Atjeh in the Leyden Museum. In 1 of the specimens from Tonga all of the IIBr series are 2, and it is rather curious that Hartlaub should not have seen that this is identical with the form described by Carpenter as *Actinometra valida*.

In 1898 Prof. Ludwig Döderlein recorded specimens of this species (as *parvicirra*) from Amboina, in 1900 Prof. Georg Pfeffer recorded a specimen (as *litoralis*) from Ternate, and in 1904 Mr. Herbert Clifton Chadwick recorded specimens (as *parvicirra*) from Ceylon.

In 1908 I described as a new species *Comanthus intricata* based on a specimen from Bowen, Queensland, in the Copenhagen Museum, which bore Lütken's manuscript name *Actinometra intricata*. Misled by the allocation of *intricata* by Carpenter and by Hartlaub, I said that this is not the *Actinometra intricata* of Lütken, 1874, and following authors, "which is the *Comatula rotalaria* of Lamarck, 1816, of which the *Alecto parvicirra* of Müller, 1841, is a synonym."

I soon discovered that my *Comanthus intricata* is the same as Carpenter's *Actinometra valida* and that Carpenter's *Actinometra littoralis* is also a synonym of the latter, and in my report on the crinoids of the Copenhagen Museum published in 1909 I placed the type specimen of *intricata* under the heading *Comanthus* (*Comanthus*) *valida*. In explaining this disposition of *intricata* I said that I was quite unable to find any valid characters by which *intricata* may be distinguished from the previously described *valida*, and remarked that I had been misled by the fact that Carpenter made *valida* the type of a special group, the *Valida* group, apart from the *Parvicirra* group into which *intricata* obviously falls.

When I described *intricata* I had not yet discovered that the *Valida* group is composed of 4 supposed species 3 which are synonymous with *parvicirra* of the *Parvicirra* group, while the fourth is synonymous with my *intricata* and, as shown by some specimens received just after *intricata* was described which had been dredged by the *Albatross* in the Philippines, also with Carpenter's *littoralis* of the *Parvicirra* group.

In this same paper under the heading *Comanthus* (*Comanthus*) *rotalaria* [= *Comanthus parvicirra*] I recorded a specimen from Tonga with 34 arms, 1 from Fiji with 38 arms, and 1 from Singapore with 41 arms which are evidently *timorensis*.

In 1910 I examined the type of Carpenter's *Actinometra meyeri* at Hamburg and of Bell's *Actinometra annulata* and Carpenter's *Actinometra valida* at London and found that they all represented the same species, which was the same as that represented by my *Comanthus intricata*.

In my memoir on the crinoids of Australia published in 1911, I included all of these under the heading *Comanthus* (*Vania*) *annulata*, at the same time describing 2 immature individuals from Port Denison, and recording 2 specimens in the United States National Museum from Torres Strait. A complete account of this species, so far as concerns Australia, and an annotated synonymy was given.

In a report on the crinoids collected by the Hamburg southwest Australia expedition in 1905, which was also published in 1911, I described a specimen from station 26 and 4 presumably from the vicinity of Perth. A summary of the information regarding this form was given. In the list of localities there is a curious error, Atjeh being given as in Burma instead of in Sumatra.

In the paper on the crinoids of the Leyden Museum I included under *Comanthus parvicirra* the types of Müller's *Alecto timorensis* and a specimen from the Indian Ocean collected by George Bennett (the last the same as that recorded from the East Indies by Carpenter in 1881) which should have been referred to this species.

In an appendix to my report on the crinoids of the Leyden Museum published in 1911 Dr. R. Horst noted that 2 specimens had accidentally not been recorded, 1 of which was *Comanthus parvicirra* from Atjeh. Hartlaub had mentioned this specimen in 1891 under the name of *parvicirra*, and undoubtedly Doctor Horst took the name from Hartlaub's label.

In a paper published in 1911 I recorded this species, as *Comanthus* (*Comanthus*) *annulata*, from 3 localities in the Philippines where it had been collected by the *Albatross*.

In a report on the crinoids of the Hamburg Museum published in 1912 I listed and gave notes upon all the specimens in that institution excepting, apparently, one from Tonga which had been previously mentioned by Hartlaub.

In my memoir on the crinoids of the Indian Ocean published in 1912 I gave a synonymy of this species and a list of all the localities from which it is known. The first locality was "Atjeh, Burma," a repetition of the error made in the previous year. The type specimen of Bell's *Actinometra annulata* was identified as described above under "Notes."

Three of the specimens from Galle, Ceylon, and that from Port Blair listed under *Comanthus parvicirra* seem to be more properly referable to *timorensis*.

In a paper on the crinoids of the Solomon Islands published in 1912 I recorded a specimen which had been collected by H. M. S. *Penguin*, and in a paper on the crinoids of the Berlin Museum published in the same year I recorded specimens from New Guinea, St. Matthias Island, and Batjan.

Dr. August Reichensperger in 1913 recorded from the Aru Islands a specimen of *Comanthus parvicirra* with 43 arms, which undoubtedly, as suggested by Dr. H. L. Clark in 1921, is a representative of *timorensis*.

In 1913 I published my notes on the specimens in the British Museum, giving a complete list of the published references to them, and in the same year I described 9 specimens from Shark Bay which had been collected by the Hamburg southwest Australia expedition.

In 1914 I recorded 9 specimens from the *Endeavour* collection which had been dredged between Fremantle and Geraldton, Western Australia.

Dr. Hubert Lyman Clark in 1915 gave a detailed account of this species as it occurs at Mer in Torres Straits, and described a new color variety to which he gave the name *Comanthus annulatum xanthum*. He also described in detail a new species which he called *Comanthus callipeplum*. In the same year he recorded and described a number of specimens from Ceylon.

In the *Siboga* report published in 1918 I gave a synonymy of this species and recorded specimens from 8 *Siboga* stations in the Lesser Sunda and adjacent islands.

I placed Dr. H. L. Clark's *Comanthus annulatum xanthum* in the synonymy of *Comanthus* (*Vania*) *annulata*, and his *Comanthus callipeplum* in the synonymy of *Comantheria briareus*. No reasons for this disposition of these forms were given at the time, since Doctor Clark's paper only reached me when the manuscript was completed and about to be sent to Holland.

In 1921 Dr. H. L. Clark published his final account of the comatulids which he had collected and studied at Mer. He took vigorous exception to the placing of his *Comanthus callipeplum* in the synonymy of *Comantheria briareus*. Since the publication of the *Siboga* report I had examined the type and only specimen of *Comanthus callipeplum* and had been unable to find any characters by which it could be distinguished from *C. timorensis* (*annulata*). But he remarked that he could not possibly concur in this conclusion.

In 1922 Dr. Torsten Gislén recorded and described a specimen which had been collected in the Bonin Islands by Dr. S. Bock, and mentioned certain features presented by a specimen from Java.

In June, 1923, Dr. H. L. Clark described 7 specimens from Wooded Isle in the Abrolhos Islands. In 1926 he recorded a specimen from Surprise Shoal, on the outer Great Barrier Reef, and in a paper supplementary to his and published at the same time Frank A. McNeill and A. A. Livingstone recorded a specimen from off Ellison Reef, both of these specimens having been collected by Mr. W. E. J. Paradice.

COMANTHUS PARVICIRRA (J. Müller)

Plate 29, Figure 88; Plate 65, Figure 184; Plate 73, Figure 200; Plate 78, Figures 209, 210; Plate 79, Figures 211–214; Plate 80, Figures 215–218; Plate 81, Figure 221

[See also vol. 1, pt. 1, fig. 160 (dorsal view), p. 223; figs. 175–180 (centrodorsal), p. 231; fig. 182 dorsal view), p. 233; figs. 243–245, 247–249 (ventral view of centrodorsal), p. 251; fig. 331 (cirrus), p. 281; figs. 420, 424–426 (basal rays), p. 321; figs. 433–440 (radials), p. 351; figs. 460–464 (dorsal view of radial pentagon), p. 357; pt. 2, fig. 133 (division series), p. 79; figs. 430–435 (pinnule tips), p. 257; figs. 652–657 (comb), p. 327; pl. 1, figs. 965–968 (radials); pl. 6, fig. 1015 (analysis of arm structure); pl. 7, fig. 1017 (dorsal view); pl. 10, fig. 1025 (analysis of arm structure); pl. 12, figs. 1034, 1035 (arm tips); figs. 1037–1039 (portions of arms); pl. 17, figs. 1079–1082 (combs); pl. 21, figs. 1123–1138 (brachials); pl. 22, fig. 1139 (division series); pl. 24, fig. 1152 (disk); pl. 25, fig. 1154 (disk); pl. 28, fig. 1175 (pinnules)]

Alecto parvicirra J. Müller, Monatsber. d. k. preuss. Akad. d. Wiss., 1841, p. 185 (description; locality unknown); Archiv f. Naturgesch., 1841, vol. 1, p. 145 (same); Abhandl. d. k. preuss. Akad. d. Wiss., 1841, 1843, p. 216 (structure).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 684 (falls into 3 of Carpenter's groups); Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 203 (type of *Comanthus*); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (identity); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 711 (history).

Comatula (*Alecto*) *parvicirra* J. Müller, Abhandl. d. k. preuss. Akad. d. Wiss., 1847, 1849, p. 260 (redescribed; Vavao, Friendly Is.).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 30 (identity).

Comatula parvicirra Dujardin and Hupé, Hist. nat. des zoophytes, Echinodermes, 1862, p. 206 (synonymy; description; habitat unknown; Paris Mus.); p. 208 (possibly includes *C. brevicirra*).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 28 (remarks on the type specimens).

Comatula brevicirra Dujardin and Hupé, Hist. nat. des zoophytes, Echinodermes, 1862, p. 208 (*nomen nudum;* possibly a synonym of *parvicirra*).—P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 205 (Vavao, Friendly Is.; *nomen nudum*).

Actinometra intricata (part) Lütken, Mus. Godeffroy Cat., vol. 5, 1874, p. 190 (Tonga; Fiji; *nomen nudum*); vol. 5, 1877, p. 100 (same).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 96 (MS. name found on specimens of *parvicirra*).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 441 (history); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 117 (identity).

Comatula mertensi Grube, Jahresber. d. schles. Gesellsch. f. vaterl. Cultur, 1875, p. 74 (description; North Borneo).

Actinometra armata (Semper, MS.) W. B. Carpenter, Proc. Roy. Soc., vol. 24, 1876, p. 451 (nervous system).—P. H. Carpenter, Journ. Anat. and Physiol., vol. 10, 1876, p. 574 (anatomy); Nature, vol. 15, Jan. 4, 1877, p. 198 (*armata* of Pourtalès an *Antedon;* of Semper an *Actinometra*).—von Graff, Das Genus *Myzostoma*, 1877, pp. 12, 13, 19, 22, 72, 79 (near Bohol, Philippines; myzostomes).—P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 50 (identity).—Perrier, Nouv. archives du mus. d'hist. nat., Paris, ser. 2, vol. 9, 1886, p. 98 (anatomy); Mémoire sur l'organisation et le développement de la Comatule de la Méditerranée, 1886, p. 50 (female genital rhachis); p. 84 (brachial anatomy).—P. H. Carpenter, Quart. Journ. Miscrosc. Sci., vol. 27, 1887, p. 389 (anatomy; criticism of Perrier).—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, pp. 184, 185 (myzostomes; from von Graff).—Hamann, Jenaische Zeitschr., vol. 23, new ser. 16, 1889, p. 296 (anatomy).

Actinometra (*Comatula*) *armata* P. H. Carpenter, Journ. Anat. and Physiol., vol. 10, 1876, pp. 574, 582; vol. 11, p. 89, fig. 1, p. 91 (anatomy).

Philippinische Comatula-Art Greeff, Sitzungsber. d. Gesellsch. zur Beförderung d. gesammten Naturwiss. zu Marburg, No. 1, Jan., 1876, p. 16 (anatomy; discussion of Semper).

Comatula polymorpha P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 441 (*nomen nudum*).

Actinometra polymorpha P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 13, 1877, p. 443 (*nomen nudum*); Quart. Journ. Microsc. Sci., vol. 18, 1878, p. 355 (clavicular piece); Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, pp. 1 and following (detailed description; structure; anatomy); p. 27 (systematic position); p. 51 (diagnosis); p. 52 (varieties 1, Ubay, and 2, Cabulan [varieties 3 and 4, p. 53=*timorensis*]); pl. 1, figs. 6–15; pl. 2, figs. 1–8, 8–10; pl. 3, figs. 2, 5–11; pl. 6, figs. 1–19; pl. 7, figs. 1–6; pl. 8, figs. 1–4; Nature, vol. 19, 1879, p. 450; Bull. Mus. Comp. Zoöl., vol. 9, No. 4, 1881, p. 161 (sense organs); p. 162 (dimorphism of arms); Quart. Journ. Microsc. Sci., vol. 21, 1881, p. 185 (anatomy).—Perrier, Nouv. archives du mus. d'hist. nat., Paris, ser. 2, vol. 9, 1886, p. 134 (anatomy); Mémoire sur l'organisation et le développement de la Comatule de la Méditerranée, 1886, p. 86 (anatomy).

Actinometra, sp. (part) P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 41, footnote 2.

Actinometra rotalaria P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position); p. 28 (3 radials, the first concealed, not 2 as described by Müller); p. 28 (found in the Paris Museum with the label *Comatula brevicirra*); Proc. Roy. Soc., vol. 28, 1879, p. 386.—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed); p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 740 and following (discussion of Bell's method of formulation and corrected formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 313; pl. 59, fig. 2.—Bell, Proc. Zool. Soc. London, 1894, p. 396 (Macclesfield Bank, 13–36 fathoms).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 716 (credited to Australia by P. H. Carpenter); p. 717 (as understood by Carpenter is not *Comatula rotalaria* Lamarck, but *Alecto parvicirra* J. Müller); Crinoids of the Indian Ocean, 1912, pp. 35, 38 (identity of previous records).

Actinometra parvicirra P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 27 (systematic position); p. 28 (Vavao variety of this species found by Carpenter in the Paris Museum with the label *Comatula parvicirra;* the type specimen does not exist in the Paris Museum under this name, nor under *C. brevicirra;* Carpenter believes that 3 small spirit specimens from Péron and Lesueur, 1803, which with 2 specimens of *pectinata* are labeled *C. simplex*, are really those described by Müller); Notes from the Leyden Mus., vol. 3, 1881, p. 204 (Vavao, Friendly

Is.; Philippines; Kupang; Timor; Solor I.; Ubay; south coast of Ceram); Journ. Linn. Soc. (Zool.), vol. 16, 1882, p. 519.—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed); p. 535 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882, 1883, pp. 732 and following (discussion of Bell's method of formulation and corrected formula).—Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 168 (Warrior reef; Port Molle; Peru).—von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 20, 32, 37, 40, 54 (Bohol, Philippines; myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, pp. 50, 52, 57, 67, 102, 103, 107, 120, 121, 124, 133, 283, 337 (structure); pl. 61, figs. 2–5; Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1886, p. 475 (no cirri of the small mature type).—Perrier, Nouv. archives du mus. d'hist. nat., Paris, ser. 2, vol. 9, 1886, p. 153 (structure); Mémoire sur l'organisation et le développement de la Comatule de la Méditerranée, 1886, p. 105 (anatomy).—P. H. Carpenter, Ann. and Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 39.—Bell, Trans. Dublin Soc., ser. 2, vol. 3, 1887, p. 645 (Ceylon).—von Graff, *Challenger* Reports, Zoology, vol. 20, pt. 61, 1887, p. 10 (Samboangan; myzostomes); Proc. Zool. Soc. London, 1888, p. 384 (Tuticorin, Madras); p. 387 (occurs in the Bay of Bengal).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 338 (description; localities; remarks); pl. 61; pl. 67, figs. 3, 4.—Hamann, Jenaische Zeitschr., vol. 23, new ser. 16, 1889, p. 234 (anatomy).—P. H. Carpenter, Journ. Linn. Soc. (Zool.), vol. 24, 1891, p. 68 (*Antedon rosacea* even more variable than this species).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 5 (noteworthy on account of the number of individuals in Brock's collection from Amboina); p. 11 (collected by Brock at Amboina); p. 96 (*intricata*, *guttata*, and *trachygaster* of Lütken are synonyms; Amboina; Peru; Samoa; Mortlock I.; Panopé; Lombock Strait; Fiji; Tonga; Moreton Bay; Atjeh; characters; 2 types); p. 113 (in Göttingen Mus.).—Bateson, Materials for the Study of Variation, 1894, p. 421 (individual having only 2 radials on 1 ray); fig. 126.—Bell, Proc. Zool. Soc. London, 1894, p. 394 (northwest Australia, 9 fathoms); p. 396 (Macclesfield Bank, 10–36 fathoms).—Thurston, Madras Gov't Mus. Bull., No. 2, 1894, p. 106 (Gulf of Manaar; littoral); p. 114 (Tuticorin, on stems of gorgonians).—Koehler, Revue suisse de zool., vol. 3, 1895, p. 289 (Bay of Amboina; notes).—Döderlein, Denkschr. d. medicin-naturwiss. Gesellsch. Jena, ser. 8, vol. 5, 1898, p. 479 (Amboina); pl. 36, figs. 5, 5*a*.—Bell, Willey's Zool. Results, vol. 2, 1899, p. 134 (Sandal Bay, Lifu).—Pfeffer, Abhandl. d. Senck. naturwiss. Gesellsch., vol. 25, 1900, p. 85 (Ternate).—Chadwick, in Herdman, Report Ceylon Pearl Oyster Fisheries, pt. 2, suppl. rep. 11, 1904, p. 153 (occurs at Ceylon); p. 158 (stations IX, XLVI, LIV, LVII, LXIII, LXIX; characters; specimen from Station XLI is *Comissia chadwicki;* other specimens are *C. timorensis*).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—Reichensperger, Zool. Anzeiger, vol. 33, No. 11, August 18, 1908, pp. 363–367 (glandular structures).—A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, pp. 714, 716, 717, 719, 720 (identity of previous records); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (Batjan); Crinoids of the Indian Ocean, 1912, pp. 31, 36–41 (identity of previous records).—Hartlaub, Mem. Mus. Comp. Zoöl., vol. 27, No. 4, 1912, pp. 281, 414 (listed); pp. 475, 476 (Yeddo; Kingsmill Is.; notes).—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 77 (identity of records based on specimens in the British Museum).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, pp. 15, 17 (discussion).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 5 (identity).

Actinometra, sp. P. H. Carpenter, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 40, footnote 3 (specimens from Banda and from the Admiralty Is.).—Perrier, Mémoire sur l'organisation et le développement de la Comatule de la Méditerranée, 1886, p. 58, footnote (correction of Teuscher).

Actinometra, sp. nov. P. H. Carpenter, Popular Sci. Rev., vol. 4, No. 15, 1880, pl. 6, fig. 1 (piece of a grooved arm seen from above; Philippines); fig. 2 (piece of an ungrooved arm of the same specimen); figures apparently redrawn from 1879, pl. 2, figs. 3, 5.

Aetinometra parvicirra P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 204 (typographical error).

Comatula simplex (Troschel, MS.) P. H. Carpenter, Notes from the Leyden Mus., vol. 3, 1881, p. 205 (Australia).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 155 (anticipates *Actinometra simplex* P. H. Carpenter, 1888); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 246 (identity).

Antedon mertensi Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed).

Actinometra cumingi Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 155 (specific formula); p. 167 (Port Molle); Sci. Trans. Roy. Dublin Soc., ser. 2, vol. 3, 1887, p. 645 (Ceylon).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 301 (Port Molle).—Thurston, Madras Gov't Mus. Bull. No. 2, 1894, p. 117 (Tuticorin).—Chadwick, in Herdman, Report Ceylon Pearl Oyster Fisheries, vol. 2, suppl. rep. 11, 1904, p. 153 (Ceylon; after Bell).—A. H. Clark, Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 75 (identity of Bell's and Chadwick's Ceylon records; B. M., MS. is *Comanthus parvicirra*).

Actinometra cumingii Bell, Report Zool. Coll. H. M. S. *Alert*, 1884, p. 167 (Port Molle); Proc. Zool. Soc. London, 1888, p. 387 (Bay of Bengal); 1894, p. 402 (Malacca [but not Queensland]).—A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 714 (of Bell, 1884=*Comanthus parvicirra*); p. 716 (credited to Australia by P. H. Carpenter; =*Comanthus parvicirra*); p. 799 (of Bell, 1884, Port Molle=*Comatula rotalaria*); Crinoids of the Indian Ocean, 1912, pp. 31, 284 (of Bell, 1884 and 1887=*Comanthus parvicirra*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 75 (identity of Bell's record, 1884).

Actinometra mutabilis (Lütken, MS.) von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 13, 14, 20, 31, 43 (23° 20′ N., 118° 30′ E., 17 fathoms; 23° 20′ N., 118° 38′ E., 17 fathoms; Tonga; myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 338 (in synonymy); p. 341 (Moreton Bay, Fiji; Nicobar Is.).—Braun, Centralbl. f. Bakteriol. u. Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; from von Graff).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, p. 98, 1891 (MS. name of Lütken found on specimens from Moreton Bay).

Actinometra trachigaster Perrier, Nouv. archives du mus. d'hist. nat., Paris, ser. 2, vol. 9, 1886, p. 116, footnote.

Actinometra annotea Bell, Sci. Trans. Roy. Dublin Soc., ser. 2, vol. 3, 1887, p. 645 (in synonymy; error for *armata*).

Actinometra simplex P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 312 (description; Admiralty Is., 16–25 fathoms); pl. 59, fig. 1.—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).

Actinometra elongata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 311 (description; Banda); pl. 17, figs 2–4.—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1585 (listed).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 440 (name found to be preoccupied and changed to *Comatula helianthus*); Crinoids of the Indian Ocean, 1912, p. 35 (synonym of *parvicirra*); Smiths. Miscell. Col., vol. 61, No. 15, 1913, p. 75 (same).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 17 (combs on distal pinnules; Banda; should go in *Comaster*); Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 53 (*Comaster* type of comb).

Actinometra quadrata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 331 (description; Tongatabu reefs); pl. 62, fig. 1.—Minckert, Archiv f. Naturgesch., Jahrg. 71, 1905, vol. 1, Heft 1, p. 226 (regeneration).—Hamann, Bronns Klassen u. Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1586 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 36 (synonym of *parvicirra*); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 78 (same).—Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 18 (combs as far as the twentieth brachial; should go in *Comaster*); Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 53 (*Comaster* type of comb).

Actinometra variabilis Bell, Proc. Zool. Soc. London, 1894, pp. 394, 396 (Bassett-Smith Bank, 9 fathoms).

Actinometra elongata var. Pfeffer, Abhandl. d. Senck. naturf. Gesellsch., vol. 25, 1900, p. 85 (Ternate).

Actinometra parvicurva Springer, Mem. Mus. Comp. Zoöl., vol. 25, No. 1, 1901, p. 88 (both sides of the Pacific; range).

Comatula orientalis A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 155 (new name for *Actinometra simplex* P. H. Carpenter, 1888, not of P. H. Carpenter, 1881).

Comaster orientalis A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Comaster parvicirra A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Comaster rotalaria A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1908, p. 686 (listed).

Phanogenia orientalis A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Phanogenia parvicirra A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Phanogenia rotalaria A. H. Clark, Proc. U. S. Nat. Mus., vol. 35, 1908, p. 124 (listed).

Comanthus rotalaria A. H. Clark, Smiths. Miscell. Coll., vol. 52, pt. 2, 1908, p. 205 (*Albatross* stations 5142, 5147, 5159, 5163, 5205; Pangasinan I.; Tataan Is.; Philippine Is., with no further data; discussion; *parvicirra* same as *rotalaria* as described by P. H. Carpenter); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 397 (*Albatross* stations 5218, 5248, 5253, 5254); Zool. Anzeiger, vol. 34, No. 11-12, 1909, p. 365 (Timor; no locality); p. 366 (listed); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 507, footnote (identity of "Peru" as a locality for this species); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 127 (identity of "Peru"); p. 193 (collected at Singapore by Svend Gad); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (identity).

Comanthus (*Comanthus*) *rotalaria* A. H. Clark, Proc. U. S. Nat. Mus., vol. 37, 1909, p. 30 (compared with *C.* [*C.*] *samoana*); Vidensk. Medd. fra den naturhist. Forening i København, 1909, p. 144 (includes *parvicirra, timorensis, wahlbergii, brevicirra, trachygaster, intricata* [part], *mertensi, armata, polymorpha, simplex, meyeri, mutabilis, annotea, elongata, quadrata, guttata, orientalis,* and *helianthus;* Tonga Is.; Fiji; Nicobar Is.; China Sea; off the Goto Is.; near the Pescadores Is.; Singapore; ?Australia; descriptions of specimens).

Comanthus (*Comanthus*) *parvicirra* A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 536 (*Albatross* stations 5413, 5414; *Comatula rotalaria* Lamarck is the same as *Actinometra jukesii* P. H. Carpenter and *Actinometra paucicirra* Bell; *Actinometra rotalaria* of P. H. Carpenter, 1888, is the same as *Alecto parvicirra* J. Müller).

Comanthus parvicirra A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (southeast coast of Africa); p. 17 (characters separating this from *wahlbergii*); p. 19 (specimen from Cape St. André, Madagascar, 30 m., may possibly be this species); p. 20 (specimens from Mauritius in the British Museum may possibly be this species); Notes from the Leyden Mus., vol. 33, 1911, p. 176 (includes *timorensis*); p. 181 (revised synonymy; Indian Ocean; Ceram; Timor; Solor Is.; descriptions of specimens); p. 192 (Atjeh); Ann. and Mag. Nat. Hist., ser. 8, vol. 7, 1911, p. 645 (10-armed specimen figured by Chadwick is a species of *Comissia*); Bull. du mus. d'hist. nat., Paris, 1911, No. 4, p. 244 (=*Alecto parvicirra* J. Muller); p. 246 (=*Comatula simplex* Dujardin and Hupé); p. 249 (New Caledonia; Australian seas; Cape Baudin; Australia; Vavao; Cape St. André, Madagascar, about 30 m.; descriptions of the specimens); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 439 (East Indian species occurring south to Fremantle and Moreton Bay); p. 443 (range on the east coast); p. 444 (range on the west coast); p. 446 (summary of west Australian records); Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 708 (anatomy studied in part); p. 717 (known to P. H. Carpenter from Australia); p. 721 (occurs south to Port Molle); p. 723 (northwest Australia; Baudin I.; Fremantle); p. 733 (in key); Records of the Australian Mus., vol. 9, No. 1, 1912, p. 82 (compared with *C. samoana*); Smiths. Miscell. Coll., vol. 60, No. 10, 1912, p. 10 (Peru; description of specimens previously recorded by P. H. Carpenter and by Hartlaub; possible identity of Peru; Moreton Bay; Sulu [Jolo] Archipelago; Lombok Strait; Tonga and Fiji; Ternate; Pitilu, Admiralty Is.; Ekalin, St. Matthias I.; descriptions of specimens); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 385 (identity of specimen from Batjan recorded by Carpenter; identity of *Comanthus rotalaria* A. H. Clark, 1909); p. 392 (Amoy; Ovalao, Fiji; Amboina; Friedrich-Wilhelms-Haven, New Guinea; Atapupu, Timor; Batjan); Crinoids of the Indian Ocean, 1912, pp. 30, 31, 35, 37, 38, 39, 40 (identity of previous records); p. 97 (synonymy; new localities; summary of previous records; discussion); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 178 (range in east Asia); Smiths. Miscell. Coll., vol. 61, No. 15, 1913, p. 18 (published references to specimens in the British Museum; localities represented by these; characters); p. 75 (identity of *Actinometra cumingii* Bell, 1884, 1887, 1888, Chadwick, 1904, and B. M., MS.;

Actinometra elongata P. H. Carpenter, 1888, is this species).—Reichensperger, Abhandl. Senck. naturf. Gesellsch., vol. 35, Heft 1, 1913, p. 82 (Aru Is.); p. 83 (Amboina; Ceylon); p. 88 (details of localities and characters of the specimens).—A. H. Clark, Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 115 (an East Indian species).—H. L. Clark, Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 134 (coast of Western Australia).—A. H. Clark, Internat. Revue d. gesamt. Hydrobiol. u. Hydrogr., 1915, p. 223 and following (detailed account of the distribution in Australia).—Hartmeyer, Mitt. zool. Mus. Berlin, vol. 8, Heft 2, 1916, p. 234 (Amboina, No. 5284; New Guinea, No. 5944; ?locality, Nos. 5418, 5332).—A. H. Clark, Unstalked Crinoids of the *Siboga* Exped., 1918, p. 50 (in key; range); pp. 271–276 (listed); Smiths. Miscell. Coll., vol. 72, No. 7, 1921, p. 24 (swimming).—H. L. Clark, The Echinoderm Fauna of Torres Strait, 1921, p. 6 (history); p. 8 (secured by the Carnegie Exped., 1913); p. 19 (range; color; comparison with *luteofusca;* Reichensperger's record from the Aru Is. probably *annulata*); p. 192 and following (range); pl. 1, figs. 5, 7 (colored); Journ. Linn. Soc. (Zool.), vol. 35, 1923, p. 231 (Abrolhos Is.); p. 234 (Wooded Isle; characters).—Gislén, Zool. Bidrag från Uppsala, vol. 9, 1924, p. 11 (posterior arms do not end in an axillary with 2 equal pinnules as stated by P. H. Carpenter and A. H. Clark); p. 44 (lack of reversion); p. 88 (synarthries).

Comanthus (*Validia*) *parvicirra* A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 18 (synonymy); p. 19 (some specimens from the Seychelles, 34 fathoms, possibly this species; others from the Red Sea collected by Hartmeyer may be this species [=*Comissia hartmeyeri*]); vol. 43, 1912, p. 385 (specimens from the Seychelles are *Comissia ignota*; those from the Red Sea are *Comissia hartmeyeri*).

Comanthus, sp. A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 19 (Cape St. André, Madagascar, about 30 m.; description of a specimen; possibly *C. parvicirra*); p. 20 (Mauritius; close to, if not, *C. parvicirra*); Crinoids of the Indian Ocean, 1912, p. 99 (same).

Comanthus (*Vania*) *parvicirra* A. H. Clark, Memoirs Australian Mus., vol. 4, pt. 15, 1911, p. 758 (annotated synonymy; characters; Port Molle; summary of additional Australian records; distribution; discussion of synonyms and of previous confusion with *annulata*); Records of the Western Australian Mus., vol. 1, pt. 3, 1914, p. 114 (collected by the *Endeavour* in Western Australia); p. 121 (between Fremantle and Geraldton; characters of the specimens); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 214 (Malayan species; range and its significance); Unstalked Crinoids of the *Siboga* Exped., 1918, p. 54 (synonymy; notes; stations 40, 43, 58, 60, 78, 79*b*, 81, 96, 99, 131, 133, 144, 162, 172, 234, 240, 273, 282, 294, 303, 310, 315; Maumeri).—Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 50 (Bock's stations 40, 49, 63; notes); p. 53 (pinnule combs); figs. 41–45, p. 70.

Comanthus parvicirrum H. L. Clark, Carnegie Institution of Washington Publication 212, 1915, p. 103 (Mer); Spolia Zeylanica, vol. 10, pt. 37, 1915, p. 84 (Ceylon; 1 small specimen with 21 arms); p. 92 (occurs at Ceylon).

Comaster typica Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 3 (listed); p. 5 (Mjöberg's station 5); p. 9 (detailed descriptions of the specimens); fig. 3, p. 13 (tip of a genital pinnule, with comb); pl. 1, fig. 3; Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 50, 54 (synonym of *Comanthus parvicirra α comasteripinna*), .

Comaster multifida Gislén, Kungl. svenska Vetenskap. Handl., vol. 59, No. 4, 1919, p. 3 (listed); p. 5 (Mjöberg's station 5); p. 14 (notes and remarks).

Comanthus (*Vania*) *parvicirra a comasteripinna* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 4.

Comanthus parvicirra α comasteripinna Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5. No. 6, 1922, p. 50 (*Comaster multifida* and *C. typica* Gislén, 1919, included as synonyms; Bock's stations 40, 49, 63; notes); figs. 41–43, p. 70.

Comanthus (*Vania*) *parvicirra β comanthipinna* Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 51 (Bock's station 40; description and notes); figs. 44, 45, p. 70.

Comanthus parvicirra γ vanipinna Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 51 (Sagami Bay, Mortensen; specimen from Bock's station 63 tentatively referred to this form); fig. 3, p. 13.

Vania parvicirra Gislén, Nova Acta reg. Soc. sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 53 (combs).

Diagnostic features.—The arms are less than 30, usually about 20, in number. They may be all rather short and stout, equal or subequal in length, or the anterior may be greatly elongated and distally excessively attenuated. The cirri are few in number and are irregularly distributed about the periphery of a thin subcircular or irregularly pentagonal centrodorsal, being not infrequently confined to the interradial angles. Mature cirri consisting of 11–14 (usually 12–13) segments are usually present, but in rare cases cirri may be wholly absent.

Notes.—The specimen from Cape St. André, Madagascar, has 23 arms, of which the several postradial series bear 4 (3+1), 5 (1+4), 5 (4+1), 2, and 7 (4+3). One of the IIIBr series, internally developed, is 2, all of the other division series being 4 (3+4). The arms are undergoing adolescent autotomy. The cirri are XIII, 13–14, slightly more developed than usual and also more compressed laterally and recurved distally. The interradial perisome is strongly plated.

Of the 2 specimens from the Seychelles, 1 is typical, with 20 arms and IV cirri; the other is small.

The 2 specimens from Mauritius are small, with 13 and 14 arms. They are very close to, if not, this species.

Of the 2 individuals from Gwada, Baluchistan, 1 has 25 arms 60 mm. long. The other is smaller, with 21 arms.

The specimen from ?India has 20 arms 150 mm. long, though the calyx and arm bases are no larger than in individuals with half this arm length.

The examples from Galle, Ceylon, show the following characters.

The 20 arms are 75 mm. long. One of the IIBr series is absent, and there is a single IIIBr 4 (3+4) series.

The 22 arms are 75 mm. long.

A medium-sized example has 20 arms.

A small individual has 22 arms 70 mm. long.

The 21 arms are 75 mm. long. Three IIIBr series are present, and 2 of the IIBr series are absent.

The 20 arms are 60 mm. long.

A small specimen has 18 arms.

Chadwick confused this form both with *Comanthus timorensis* and with *Comissia chadwicki*. He wrote that the number of arms varies from 10 in a specimen from station XLI (=*Comissia chadwicki*) and 11 in one from station LVII (=*parvicirra*) to 48 in one from station IX (=*timorensis*). The specimens with 44 and 48 arms mentioned by him are *timorensis*. He noted that IIBr 2 series occur in most of the specimens.

One of the specimens from Ceylon in the British Museum, which was originally recorded by Bell, has 20 arms.

The specimen from Ceylon recorded by Dr. H. L. Clark has 21 arms.

Of the 4 specimens recorded by Reichensperger from Ceylon, 3 have 20 arms and 1 has 23 arms. Of the 20-armed specimens the arms reach 95 or 100 mm. in length. The cirri are XI–XIV, weak and slender, slightly broadened distally, rarely exceeding

5 mm. in length. The disk is more or less granulated, always finely, the granulation appearing dustlike. The 23-armed example has an arm length of 105 mm. There are 3 IIIBr 4 (3+4) series. The cirri are VII. The color in all as preserved is dark brown.

The specimen from off Contors Island has several IIIBr series developed.

The example from *Investigator* station 7 has 8 IIIBr 4 (3+4) series developed, and 2 IIBr series lacking. Two of the IIBr series are 2.

The specimen taken at the surf line in the Andamans has 28 arms 110 mm. long. The 3 other specimens from the Andamans are small and medium sized.

The 2 specimens from the Nicobar Islands, which bear Lütken's manuscript name *Actinometra mutabilis*, both have 20 arms. One has all the division series beyond the IBr series 4 (3+4). The arms are 50 mm. long, and the cirri are IX, 12–13, 5 mm. long. The other has 6 of the IIBr series 2 and four 4 (3+4). The arms are 105 mm. long. There are no cirri, the centrodorsal being small and very thin, roughly circular, and separated from the radials by deep clefts which are bridged over at the angles of the calyx by the ends of the basal rays.

Carpenter mentioned one of these specimens as a tridistichate individual which he found under the name of *Actinometra mutabilis* in the Copenhagen Museum, and said that he subsequently saw a similar one in Vienna. He remarked that the brachials are rather long in both cases, and said that without making a renewed examination of the specimens he would not like to speak positively as to their nature, "but they must certainly belong either to *Actinometra quadrata* or to *Actinometra parvicirra*."

The specimens from Singapore are all medium sized or small.

The specimen from Sumatra has 18 arms, one of the rays having no IIBr series. Of the 8 IIBr series, 7 are 4 (3+4) and 1 is 2. The centrodorsal is a very thin, irregularly rounded plate which is not quite sunken to the level of the radial pentagon.

The example from Sebesi Strait has 21 arms.

The specimen from the Danish expedition to the Kei Islands station 74 has 20 arms; of the 9 IIBr series present, 8 are 4 (3+4) and 1 is 2; there is a single IIIBr 4 (3+4) series externally developed. The specimen from station 104 has 23 arms, of which the longest are 110 mm. long. All the division series are 4 (3+4). There are III small weak cirri, and in addition some rudimentary.

The specimen from *Siboga* station 315 has 15 arms 30 mm. long. Three of the IIBr series are 2 and 2 are 4 (3+4).

Of the specimens from *Siboga* station 40, one has 21 arms 70 mm. long. Nine of the IIBr series are 2, and only one is 4 (3+4). There is a single IIIBr series, developed internally. The other, which is similar, also has 21 arms. All 10 of the IIBr series are 2. The single IIIBr series is 4 (3+4).

The specimen from *Siboga* station 43 is small, with 17 arms and V cirri.

The example from *Siboga* station 310 is small, with 13 arms, and is undergoing adolescent autotomy. There is a single IIBr 2 series bearing 2 IIIBr 4 (3+4) series.

One of the specimens from Maumeri has 21 arms 80 mm. long. Three of the IIBr series are 2, all the other division series being 4 (3+4). The single IIIBr series is externally developed. The cirri are XIV and are slightly larger than usual. The other is smaller, with 20 arms. There are present 9 IIBr series, of which 4 are 2 and 5 are 4 (3+4). The single IIIBr series, which is 2, is internally developed on a ray with 2 IIBr 2 series.

One of the specimens from Solor is small, with 20 arms and the cirri X. The other is medium sized, with 24 arms and the cirri IX. In both the cirri are comparatively well developed and show an approach to the type found in *Comanthus samoana*.

Carpenter said of these specimens that they are of the same type as the originals of Müller's *Alecto timorensis*. They both agree in the relatively small size of P_2 and in having the terminal comb on the lowest pinnules longer than in the Timor specimens (*timorensis*), though the number of pinnules bearing it is small, not more than 5 or 6 on each arm. The overlap of the brachials also is less marked. Carpenter added that, while resembling one another in their differences from the types of *timorensis*, the 2 specimens from Solor are nevertheless very unlike. The smaller one has stiff pinnules which are not well clothed with perisome, while in the other, which is but little larger,the pinnules of the lower and middle parts of the arm are stout and fleshy, very much as in one of the Ubay varieties of the Philippine series. The mouth, too, does not occupy its usual interradial position, and the anus is not quite in the center of the disk. The arms of both individuals, though all grooved, are dimorphic, the posterior ones being shorter and tapering more rapidly than the anterior.

The specimen from *Siboga* station 58 is small, with 14 arms.

The 13 specimens from *Siboga* station 60 are all medium sized, with the cirri irregular in occurrence and, though present in all, slender and weak. They present the following characters:

The 22 arms are 80 mm. long. All of the IIBr series are present, and there are 2 IIIBr series on a single IIBr series. The cirri are I, 11, 6 mm. long.

There are 21 arms, and V rudimentary cirri on a single semicircumference of the centrodorsal.

There are 20 arms. The cirri are X, 6 mm. long.

There are 19 arms; 2 of the IIBr series are absent, and a single IIIBr series is present. There are V cirri.

There are 19 arms, one of the IIBr series being absent, and a single cirrus.

There are 17 arms and VI cirri 5 mm. long.

There are 17 arms and IV cirri.

There are 17 arms and IV cirri.

There are 19 arms, one of the IIBr series being absent, and IX cirri.

There are 16 arms, one postradial series having 2 IIBr series. The cirri are V.

There are 15 arms and IX cirri.

There are 15 arms and VII cirri.

There are 14 arms, 2 of the postradial series having 2 IIIBr series each, and IV cirri.

The specimen from *Siboga* station 303 has 17 arms 95 mm. long. Of the 7 IIBr series, 5 are 4 (3+4) and 2 are 2. There are IV cirri, all broken.

Of the 3 small specimens from *Siboga* station 294, 1 has 12 and 2 have 11 arms.

The 2 specimens from Atapupu, Timor, both have about 20 arms. One has 4 of the IIBr series still attached, 3 of which are 2, while the other is 4 (3+4). The other has 5 IIBr series in place, 2 of them being 2 and the other 3 being 4 (3+4). One of the specimens has I and the other no cirri.

Carpenter said that the specimen from Kupang, Timor, which he examined in the Berlin Museum has 20 arms and is peculiar for the small size of P_2, which is less than half the length of P_1.

Of the 6 specimens from *Siboga* station 282, 5 are small. The other has 22 arms which are thus distributed: 1+2, 4+1, 4+4, 1+3, 2. All of the division series are 4 (3+4). The cirri are very short, but are slightly more robust than usual, tending toward the type characteristic of *C. samoana.*

The 3 specimens from *Siboga* station 144 are all young. One has 12 arms 70 mm. long, both of the IIBr series being 4 (3+4); there are IV small cirri. The 2 others have 10 arms; one is the same size as the preceding, and the other is small.

One of the *Challenger* specimens from Banda was described as a new species by Carpenter under the name of *Actinometra elongata.* As given by him the characters are as follows:

The centrodorsal is a small thin disk.

The cirri are about X, 12–14; a few of the segments are longer than broad.

The radials are visible. The IBr_1 are partly united laterally, but the remainder of the division series are well separated. The IIBr series are 2.

There are 18 arms, of which the anterior reach 110 mm. in length, tapering very slowly and consisting of 120 quadrate brachials, of which the middle and later ones are very long, while the posterior reach only 45 mm. in length and taper rapidly, and consist of about 55 shorter, but still quadrate, brachials.

Syzygies occur between brachials 3+4, again from between brachials 7+8 to between 11+12, and distally at intervals of about 4 muscular articulations.

The pinnules diminish from P_1, which reaches 8 mm. in length, to those of the fifth and sixth brachials, and then increase again, becoming very long and slender at the ends of the arms. The first 6 or 8 have a slight terminal comb which occurs at intervals to far out on the arm. The later pinnules of the posterior arms have "ovoid bodies" on their dorsal edge.

The mouth is nearly radial, and the disk is naked. The color in alcohol is greenish gray.

Carpenter's figure is not wholly in accord with his description. It shows an undeveloped specimen of *parvicirra* with 19 arms. Of the 8 IIBr series present, 6 are 2 and 2 are 4 (3+4). The single IIIBr series, which is not mentioned by Carpenter, is 4 (3+4). The single arm drawn is of the attenuate type, which is of rather frequent occurrence in this species in the East Indian region.

Another *Challenger* specimen from Banda in the British Museum identified by Carpenter as *parvicirra* has 18 arms and IV cirri.

The *Siboga* specimen from the reef at Banda is small, with 11 arms. Of the 2 dredged by the *Siboga* at Banda in 9–36 meters, 1 has 14 arms about 40 mm. long, and the other, which is undergoing adolescent autotomy, has 12 arms about 40 mm. long.

The specimens from off Neira, Banda, show the following features:

There are 26 arms, the longest 130 mm. and the shortest 65 mm. long. The 10 IIBr series and the 6 IIIBr series are all 4 (3+4). Of the latter, 4 are developed on a single ray, and there is a single one, external, on an adjacent ray.

There are 24 arms, the longest 164 mm. and the shortest 65 mm. long. The 10 IIBr series are all 4 (3+4). The 4 IIIBr series, which are all internally developed, are also 4 (3+4). There are II small weak cirri and some very small rudiments.

A very slender specimen has 29 arms from 50 to 80 mm. in length. The 10 IIBr series are all 4 (3+4) and the 9 IIIBr series are also all 4 (3+4). Of the latter, 4 are on a single ray; 2, both internally developed, are on another; a single 1, internally developed, is on each of 2 rays; and the last ray bears 1 externally developed.

A specimen with 20 arms has the arms excessively elongated and attenuated. Of the 10 IIBr series, 8 are 4 (3+4), and 2, both on a single ray, are 2. The cirri are V, 10–11, small and weak.

A specimen similar to the preceding has 30 arms.

A small regenerating individual has 20 arms with 6 of the IIBr series 2 and 4 of them 4 (3+4).

The last specimen resembles the others.

The specimen from off Neira in about 100–200 meters has 13 arms.

Of the specimens of *parvicirra* recorded by Hartlaub from Amboina, all, or very nearly all, appear to be in reality *timorensis*. At the Berlin Museum I examined one which might be considered *parvicirra*, though it is probably *timorensis*. It has 28 arms about 100 mm. long. Six of the IIBr series are 2 and 4 are 4 (3+4). Of the IIIBr series, 5 are 2 and 3 are 4 (3+4). Only 3 small rudimentary cirri remain.

The specimen from Amboina collected by Professor Strubell and recorded by Reichensperger has 20 arms, mostly arising through adolescent autotomy, and the very weak cirri XV, 12–13.

The specimen from the southern coast of Ceram is small, with 19 arms and no functional cirri. Carpenter described it as small and immature, and noted that P_D and P_1 are relatively rather large, the latter being considerably longer than its successor on the third (that is, fourth) brachial. He said, further, that the overlap of the brachials is but slightly marked.

The specimen from *Siboga* station 172 has 10 arms 16 mm. long.

The example from *Siboga* station 234 has 19 arms 55 mm. long. There are 9 IIBr 4 (3+4) series.

The *Challenger* specimen from Ternate has 20 arms 80 mm. long. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2.

The specimen from the Danish expedition to the Kei Islands station 15 is small, with 18 arms, and is undergoing adolescent autotomy. Of the 8 IIBr series present, 5 are 2 and 3 are 4 (3+4). One of the specimens from station 20 has 20 arms 75 mm. long. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. The cirri are II, 9–10, 5 mm. long. Another large specimen has about 20 arms. Of the IIBr series, 2 are 2, the others being 4 (3+4). The centrodorsal is much reduced and is without cirri, but there are 2 obsolete cirrus sockets in each interradial angle. A third specimen has 19 arms 65 mm. long. Of the 9 IIBr series, 5 are 4 (3+4) and 4 are 2. The cirri are VIII, 10, 4.5 mm. long. A specimen with 16 arms has one of the rays curiously abnormal (see beyond). The last example has 14 arms; there are 4 IIBr 4 (3+4) series, 1 to each of 4 rays. The cirri are IX, in 4 interradial pairs, the fifth interradial angle having a single one.

The specimen from *Siboga* station 273 is small, with 10 arms. The large perisomic interradials of the young persist just above the radials in the interradial angles.

The specimen from *Siboga* station 162 is medium sized, with 14 arms.

In Bennett's specimen from the East Indies, according to Carpenter, the overlap of the brachials is nearly as marked as in the types of *timorensis*, but the spines on the outer cirrus segments are less developed, and fewer of the lower pinnules have a terminal comb. Carpenter said that this individual is remarkable for having dimorphic arms which are all grooved. The posterior arms taper much more rapidly than the anterior ones and are composed of fewer segments, but their ambulacra are nearly as well developed.

The specimen from between Fremantle and Geraldton is typical, with 22 arms 70 mm. long. Of the 10 IIBr series, 7 are 4 (3+4) and 3 are 2. There are 2 IIIBr series, one 2, developed internally, and one 4 (3+4), developed externally. The cirri are VIII, 14, 7 mm. long.

The 7 specimens from the Abrolhos as described by Dr. H. L. Clark have from 12 to 23 arms which are from 35 or 40 mm. to more than 100 mm. in length. The cirri are few and weak and have the characteristic form and proportions. The color as preserved is yellow brown.

The example from Cape Baudin has 13 arms. Of the IIBr series, 3 are 4 (3+4) and 7 are 2. The elements of the division series and the proximal brachials have the distal edges thickened and very prominent, though smooth, quite as in certain species of *Cosmiometra*. Some of the axillaries and the second segments following the axillaries have indistinct and blunt median keels, such as occur in some species of *Cosmiometra*. There are no cirri, the centrodorsal being small, flattened, and only slightly raised above the dorsal surface of the radial pentagon. The interradial perisome is filled with a large number of small calcareous plates.

In the specimen from Mjöberg's station 5 identified by Gislén as *Comaster typica* the centrodorsal does not cover the radials.

The cirri are rudimentary, VII, from 0.5 to 1.5 mm. long, indistinctly segmented, not reaching beyond the IBr_1.

Eight of the IIIBr series are 2, and 2 are 4 (3+4). The arm divisions are 1, 2, 2, 1 or 2, 2 or 2, 2, 2, 1.

The 30 arms are from 45 to 70 mm. in length. There are no swollen genital pinnules. The anal tube is subcentral and not inflated. The color in alcohol is yellowish red.

In the description of this small specimen as published, only one of the IIIBr series is given as 4 (3+4), and the number of arms is said to be 28. I am indebted to Doctor Gislén for making the necessary corrections.

It is quite possible that this is in reality an example of *Comanthus timorensis*.

In 1 of the 2 specimens from Mjöberg's station 5 identified by Gislén as *Comaster multifida* the centrodorsal is 3 mm. in diameter, slightly concave in the center and with a swollen margin.

The cirri are VII, 12–13, 5 mm. long. The first segment is three times as broad as long, the second and third are longer, and the fourth and following are about as long as broad. From the sixth onward the segments are provided with obtuse dorsal spines which are not very stout. These are developed on the distal portion of the segments. The opposing spine is not larger than the preceding spines. The terminal claw is a little longer than the penultimate segment and is curved.

The radials are visible as a narrow ring about the centrodorsal.

There are 32 arms, of which the anterior are 90 mm. long and the posterior 50 mm.

The genital pinnules are slightly swollen. The tips of the pinnules are yellowish.

In the other specimen from Mjöberg's station 5 the centrodorsal is a little thicker, flat, without a swollen margin.

The cirri are XII, 14, 6 mm. long, arranged in groups in the interradial angles. The segments are without distinct dorsal spines.

The radials are concealed. The IIBr series are 4 (3+4). Of the 11 IIIBr series present, 7 are 4 (3+4) and 4 are 2. Both of the IVBr series present are 4 (3+4).

The arms are 33 in number, the anterior 105 mm. and the posterior 60 mm. in length. The brachials have more strongly produced distal ends than is the case in the preceding specimen.

There are about 10 teeth in the combs of the proximal pinnules. The swollen genital pinnules begin at P_7, but are not very marked.

The dorsal side of the arms is yellow in alcohol.

Dr. H. L. Clark wrote that this species is the most perplexing comatulid found at Mer, for, while typical specimens are easily recognized, the intergradations with *timorensis* (*annulata*) are very puzzling. Moreover, the individuals which seem to be undoubtedly *parvicirra* differ so among themselves that it is hard to believe they represent a single species.

He figured in colors the arms of 2 specimens, and remarked that the figure of an arm of a red and white form seems very different from the arm of a grayish form. Not only in the color but also in the shape of the arm the differences are very great. But as preserved the specimens look less unlike each other, and a careful comparison fails to show any good reason why they should not both be called *parvicirra*.

He said it will be observed that the grayish individuals have the brachials yellow brown, with the articulations and the pinnules purplish brown, but the general effect both in life and in alcohol is gray. One of the most strikingly colored individuals seen was greenish yellow and rich red purple, while another has the basal half of the arms red and white, with the distal half bright greenish yellow.

He concluded that it is evident little reliance can be placed on color to help in distinguishing *parvicirra*, yet it is certain that very dark colored specimens were not noted at Mer, and, except for the grayish specimens, bright colors were the rule.

The shade of red in the red and white individuals is elusive, for while in bright sunlight it seems to be almost rose red, with less illumination it is more a dull blood red, and in shade it becomes almost a light liver brown. It is quite fugitive in alcohol, the specimen becoming more or less light brown.

Doctor Clark said that, aside from the matter of color, *parvicirra* is distinguishable from *annulata* by its lighter and more fragile structure, the presence of some cirri, and the relatively small number of arms.

Some of the specimens from Mer in the collection of the Museum of Comparative Zoölogy show the following characters:

The arms are 21 in number, 105 mm. long. Three of the IIBr series are 2.

There are 21 arms about 100 mm. long. Two of the IIBr series are 2, the remaining division series being 4 (3+4).

There are 21 arms about 80 mm. long. Seven of the IIBr series are 2.

There are 22 arms 90 mm. long. All of the IIBr series are 4 (3+4) and both of the IIIBr series are 2.

There are 20 arms. One of the IIBr series is 2, the others being 4 (3+4).

The specimen from Warrior Reef has 20 arms.

Of the 2 specimens in the British Museum from *Challenger* station 186, one has 30 arms and the other is small, with 16 arms.

The larger specimen collected by the *Alert* at Port Molle has 15 arms. There are 5 IIBr 4 (3+4) series. The cirri are IX, 11–12. The interradial plating is just beginning to develop. This is the specimen which was recorded by Bell under the name of *Actinometra cumingii*.

The 2 specimens from Port Molle in the Australian Museum have 15 and 17 arms.

Hartlaub wrote that of the 2 specimens from Moreton Bay which he found in the Hamburg Museum bearing Lütken's manuscript name *Actinometra mutabilis*, one has 6 of the IIBr series 2, while in the other all of the IIBr series are 2. Both have 19 arms and a very small centrodorsal.

I examined 3 specimens from Moreton Bay in the Hamburg Museum. Two of them have 19 arms and the third 27. All of the postradial series but 2 are regenerating at the synarthry between the elements of the IIBr series. One of the unregenerated postradial series (the right posterior) has the IBr series 6 (5+6), this bearing 2 IIBr 4 (3+4) series.

In the Paris Museum in 1910 I examined 3 small specimens which had been collected by MM. Péron and Lesueur in the Australian seas ("Mers australes") in 1803.

Carpenter examined these specimens, which he found bearing the manuscript name of *Comatula simplex*, and in 1879 considered them to be the types of Müller's *Alecto parvicirra*.

But Müller's type was without locality, and the size he gives is greater than that of any of these specimens.

Later (1881) Carpenter said that these may possibly be Müller's types, the chief difficulty in the way of this identification being the fact that in none of them do the postradial series divide more than twice, the number of arms being less than 20, while in *parvicirra*, according to Müller, there are 27 arms.

In 1888 Carpenter decided that he was mistaken in considering these as the types of *parvicirra*, and said that, although on 2 occasions he had searched carefully through the large comatulid collection in the Paris Museum, he had been unable to identify the types of Müller's species.

He wrote (1879) that these specimens all have an excentric mouth and a terminal comb on the oral pinnules, and gave the arm length as 50 mm.

Of the 3 specimens from Friedrich-Wilhelms-Haven, New Guinea, 2 are of medium size, with about 20 arms, and 1 is rather larger, with about 27 arms. All 3 have a few cirri remaining.

The *Challenger* specimen from the Admiralty Islands in 29–46 meters was described by Carpenter as a new species under the name of *Actinometra simplex*. According to him, the characters are as follows:

The centrodorsal is a thin disk bearing marginal cirri.

The cirri are about XV, 14–17. A few of the cirrus segments are longer than broad.

The radials and portions of the IBr_1 are concealed by the centrodorsal. The IBr_1 are partly united laterally. The IIBr series are 2.

The 18 arms average 45 mm. in length. The anterior arms are composed of 100 brachials, while the posterior arms consist of 45 brachials. Some of the posterior arms are grooveless. The brachials are short, subtriangular, and slightly overlapping, becoming more elongated at the ends of the anterior arms.

Syzygies occur between brachials 3+4, again at about brachials 11+12, and distally at intervals of from 3 to 5 muscular articulations.

P_1 is about 7 mm. long, and the following pinnules decrease in length to those on the fifth and sixth brachials, afterwards increasing again. The terminal pinnules of the anterior arms are very long and slender, those of the posterior arms being shorter and stouter. The first 4 pinnules on each side have a small terminal comb which is found at intervals until near the ends of the arms.

The disk is 8 mm. in diameter and bears a few calcareous granules. The mouth is interradial.

The color in alcohol is dull green dorsally, deep brown ventrally.

Carpenter said that this (*simplex*) is a curious little species which differs altogether from *elongata* in the shortness of the brachials and in the concealment of the radials. It has many resemblances to *parvicirra*, but is separated from that type by the smaller number of elements in the IIBr series. It presents, however, the same difference in the length of the anterior and posterior arms as occurs both in *parvicirra* and in *elongata*; but some of the posterior arms are ungrooved, which is not the case in *elongata*.

The specimen from Pitilu has 25 arms, of which the longest are 120 mm. in length. Eight of the IIBr series are 2 and 2 are 4 (3+4). Four of the IIIBr series are 4 (3+4) and 1 is 2. Two of the IIIBr series are developed externally and 3 are developed internally.

The example from Ekalin has 31 arms. All of the IIBr series and 2 of the IIIBr series are 2. The cirri are IV, 10–11, 6.5 mm. long.

The specimen from New Caledonia has 28 arms.

The specimen from the New Hebrides is typical.

The specimen in the Hamburg Museum labeled "Tonga and Fiji" is of medium size.

The example from Vanua Mbalavu, Fiji, is typical, with 20 arms. Of the IIBr series, 1 is 2 and 9 are 4 (3+4).

Of the 3 specimens from Suva Reef, 1 has 21 arms. In another, only 1 of the IIBr series is 4 (3+4), the others being 2.

Hartlaub recorded a specimen from Fiji in the Hamburg Museum having eight of the IIBr series 2 and two 4 (3+4), these last being on a IBr 6 (5+6) series. Evidently this is one of the specimens which I found labeled "Moreton Bay." Hartlaub gave only 2 from that locality, whereas I found 3. It is possible, of course, that he considered Moreton Bay as in Fiji, following Carpenter.

Müller wrote (1849) that the specimen from Vavao, Tonga Islands, apparently belongs to *parvicirra*. The centrodorsal is very small in comparison with the width of the division series, since not only the radials but also the IBr_1 are appressed against the corresponding ossicles on either side. Likewise the first brachials are in contact exteriorly with their neighbors, the arms being thereby increased in width.

The centrodorsal is flattened, and the slender marginal cirri are few in number.

The radials are visible. The IIBr and IIIBr series are 4 (3+4).

There are 35 arms. The brachials are smooth, with everted distal edges.

The pinnules of the division series are long. P_2 or one of the following pinnules is very small; then the length increases.

The disk is smooth. The color in alcohol is yellow.

Carpenter (1879) said that he found this specimen in the Paris Museum under the manuscript name of *Comatula brevicirra* Troschel, and that it differs from *polymorpha* (*timorensis* + *parvicirra*) in many subordinate characters, and is not absolutely identical either with the type or with any one of the 4 varietal specimens which he had examined. He said that he could not but regard it as representing another of the slight and probably very numerous modifications of this type (*polymorpha*), of which he believed it most likely that Müller's original species (*parvicirra*) is also a varietal form.

In 1881 Carpenter said that both in this specimen and in the small ones obtained by Péron and Lesueur (in the Australian Seas) the brachials overlap much more strongly than they do in Philippine examples, the distal edges of successive brachials being much more raised.

I examined this specimen in 1910. The centrodorsal is very irregular in shape. The cirrus sockets are partially obliterated. There remain only small basal portions of 4 cirri.

There are 35 arms. Three of the postradial series divide three times, thus bearing 8 arms, and the other 2 are in process of regeneration. One of the latter, the anterior, has 2+3 arms, with the IIBr series 2 and the single IIIBr series 4 (3+4); the other, the left posterior, has 2+4 arms, with the IIBr series 2, and the IIIBr series, both of which are on the same IIBr series, 4 (3+4). The division series are broad, and the arms are short and broad. The brachials have strongly produced distal ends.

This specimen probably should be referred to *timorensis* rather than to *parvicirra*.

The *Challenger* specimen from the Tongatabu Reefs was described by Carpenter as a new species under the name of *Actinometra quadrata*. He gives the characters of this new form as follows:

The centrodorsal is a small thin disk bearing a single row of marginal cirri.

The cirri are X, 11; the fourth and fifth segments are slightly the longest.

The radials are largely visible. The IBr_1 are partly united laterally, but the division series are quite free. The IIBr series are 4 (3+4).

The 16 arms are 110 mm. in length, and consist of about 120 tolerably smooth brachials. The lower brachials are triangular and relatively long, those following soon becoming distinctly quadrate, then more square, and finally elongated.

Syzygies occur between brachials 3+4, 11+12, and 16+17, and distally at intervals of from 3 to 5 muscular articulations.

P_D is about 8 mm. long, and P_2 is but little shorter. But the next pair are considerably shorter, and the size decreases to about the seventh brachial and then increases again, the terminal pinnules becoming very slender and reaching 12 mm. in length. Terminal combs occur on the pinnules of the first 9 brachials, and then irregularly as far as the twentieth.

The mouth is interradial and the disk is naked. All the arms are grooved. The disk is 8 mm. in diameter.

The color in alcohol is grayish green.

Carpenter said that this is a very elegant little species, which may be distinguished from *parvicirra* by the characters of the brachials. The lower brachials lose their triangular shape very soon and become unequally quadrate. The two sides gradually become more equal until the outline is nearly square, and finally the brachials become almost cylindrical, with slightly oblique ends. The relative length of the lower brachials varies in some of the arms.

Carpenter said that some specimens from the Nicobar Islands in the museums at Copenhagen and Vienna (see p. 638) should perhaps be referred to this species on account of the length of the brachials.

Of the 2 specimens from the Tonga Islands in the Copenhagen Museum, 1 has 34 arms with all the division series 4 (3+4) and VI cirri. The other, which bears Lütken's manuscript name *Actinometra mutabilis*, has 22 arms; of the 10 IIBr series, 8 are 2 and 2 are 4 (3+4), and the 2 IIIB series are both 4 (3+4). There are no cirri.

Carpenter's record of this species from the Gilbert Islands (1888) was based upon 2 specimens which had been sent to him by the Museum of Comparative Zoölogy, and which were subsequently studied by Hartlaub. Both now seem to have disappeared.

According to Hartlaub, 1 of these specimens had a somewhat angular centrodorsal with IX short thick cirri. Only 3 of the postradial series remain. There are no IIIBr series. The IIBr series are partly 2 and partly 4 (3+4). Judging from the portion of the animal preserved, the number of the arms should have been 20.

Hartlaub said that this specimen is intermediate between his typus A of *parvicirra* (=*samoana*) and his typus B (=*parvicirra*+*timorensis*). The triangular brachials in the proximal portion of the arm have moderately smooth edges; further out the brachials become more overlapping, but toward the arm tips more even again. The pinnule segments have the borders armed with fine spines.

Hartlaub said that the other specimen from the Gilbert Islands also is intermediate between his typus A and typus B. In contrast to the preceding, it has a large discoidal centrodorsal, and the cirri are XXIII, about 15. There are 36 arms. Of the IIBr series, 7 are 4 (3+4) and 3 are 2. The IIIBr series are all 4 (3+4). The union of the elements of the IBr series and of the first 2 elements of the IIBr and

IIIBr series is so very close as almost to be obliterated. The brachials are as in the preceding specimen. In both the color in alcohol is uniform dark brown.

I have not seen these specimens. From Hartlaub's description I suspect that the first may be a species of *Comaster*, and the second, or perhaps both, may represent *Comanthus samoana*. I am leaving them here, however, in deference to the expressed opinion of both Carpenter and Hartlaub.

The specimen from Ponapé, as described by Hartlaub, has 34 arms; of the 10 IIBr series, 5 are 4 (3+4) and 5 are 2.

This species is represented from Bock's station 49 by detached arms from 100 to 140 mm. in length which Gislén determined as *Comanthus parvicirra α comasteripinna*. The proximal portion of these arms is 2.2 mm. broad. There are 16 brachials to each 10 mm., or 13 if the syzygial pairs are counted as units. Combs with 8–10 teeth occur at least as far as the eighth or tenth pinnule.

One of the specimens from Bock's station 40 was assigned by Gislén to *Comanthus parvicirra α comasteripinna*. The centrodorsal is 3 mm. in diameter, and is raised only slightly above the dorsal surface of the radial pentagon. The cirri are arranged in a single incomplete row.

The cirri are IX, 13–15, from 4 to 7 mm. long. The first segment is short, the second and third are about as long as broad, and the sixth is the longest, half again as long as broad. From the seventh segment onward a weak dorsal prominence is developed. The opposing spine is equal to one-fifth the width of the penultimate segment in height. The terminal claw is curved and is half again as long as the penultimate segment.

The radials are six times as broad as long. The IBr_1 are four times as broad as long and are laterally united. The IBr_2 (axillaries) are three times as broad as long, low pentagonal, and free laterally. Of the IIBr series, 9 are 4 (3+4) and 1 is 2. The 4 IIIBr series are all 4 (3+4). The first segments following the axillaries are united internally. The division series are smooth.

The 24 arms are 90 mm. long. The proximal brachials are somewhat "chubby," then slightly overlapping with small spines distally. The width of the arms proximally is 1.8 mm. There are 14 or 15 brachials to each 10 mm. of arm length, or 11 if the syzygial pairs are counted as units.

Syzygies occur between brachials 3+4 (sometimes 4+5 or still later) and 11+12, and distally at intervals of 4 muscular articulations.

P_D is 12 mm. long with about 45 segments, of which 9 or 10 are involved in the formation of the comb. P_1 is 10 mm. long, with a comb consisting of 8–11 teeth. P_2 is from 5 to 7 mm. in length with 20–25 segments, of which 8 or 9 bear teeth. P_3 is 4 or 5 mm. long with 15 segments, of which 8 or 9 bear teeth. P_2 or P_3 are the shortest. There are combs on about every other pinnule as far as the twenty-fifth or thirtieth—as an example, on the fourth, fifth, seventh, ninth, eleventh, thirteenth, fifteenth, seventeenth, etc. The distal combs have about 10 teeth. The distal pinnules are 10 mm. long with 22–28 segments.

The disk is 15 mm. in diameter, without granules. The anal tube is central and is 3 mm. high. The color as preserved is dark sepia.

The other specimen from Bock's station 40 was assigned by Gislén to *Comanthus parvicirra β comanthipinna.* The centrodorsal is 3 mm. in diameter.

The cirri are VII, 13–14, from 8 to 9 mm. in length, stouter and more strongly curved than in the preceding.

The ends of the basal rays are visible interradially.

Of the IIBr series, 6 are 2 and 4 are 4 (3+4). The 2 IIIBr series are 4 (3+4).

The 22 arms are 105 mm. long. There are 12 or 13 brachials for each 10 mm. of arm length, or 10 if the syzygial pairs are counted as units. The width of the arms at the base is 2.3 mm.

The distal intersyzygial interval is 4 muscular articulations.

P_D is 13 mm. long with about 40 segments. The comb resembles that in typical species of the subgenus *Cenolia*, being composed of about 12 low thin teeth which both proximally and distally die away gradually. The tip of the pinnule has 2 or 3 smooth segments. P_1 is about 12 mm. long. P_2 is 5.5 mm. long. P_3 and the following pinnules are without a comb. The distal pinnules are 11 mm. long and are composed of 27 segments. The segments are half again as long as broad, and the 4 terminal are provided with distal hooks. The pinnules of some of the arms are without ambulacral grooves.

Three specimens collected by Prof. Edward S. Morse in Tokyo Bay were examined by Dr. Clemens Hartlaub. He noted that the centrodorsal is very flat and moderately large.

In a young individual the cirri are about XXVIII, in the older specimens about XXV, and are up to 10 mm. in length. The number of segments is at the highest 16. The fifth-seventh segments are elongated. From the eighth onward the cirrus segments bear a dorsal transverse ridge which in the terminal segments lies not at the distal edge but more in the middle of the segments. On each end this transverse ridge terminates in a spinelike point, so that when viewed from above these distal cirrus segments seem to bear 2 short spines.

The radials are concealed. The union between the elements of the IBr series and the first 2 elements of the IIBr series is extremely close. The IIBr series are 4 (3+4). There are no IIIBr series.

The arms are 19 or 20 in number. The brachials have strongly produced and overlapping distal ends.

Syzygies occur between brachials 3+4 and 11+12, and distally at intervals of usually 4 muscular articulations. The syzygial unions are not smooth, but the edges of the brachials are here produced as in the case of the other articulations.

P_D is 10 mm. long, slender, with a short comb at the end. P_1 is similar but somewhat shorter. The fourth, fifth, and sixth brachials bear similar pinnules, after which follow thick genital pinnules.

The color is uniform brown.

Hartlaub described these specimens as belonging to typus A of *Comanthus parvicirra* (= *C. samoana*), but other specimens from the same lot which I have seen seem not to differ from true *parvicirra*.

The specimen from Bock's station 63 was determined by Gislén as *Comanthus parvicirra α comasteripinna.* As described by him the centrodorsal is 1.9 mm. in diameter, the free dorsal pole being 1.6 mm. across. There is a single row of 17 cirrus sockets.

The cirri are absent.

The radials are narrow bands, almost concealed in the middle. The IBr_1 are three times as broad as long, and are free laterally. The IBr_2 (axillaries) are twice as broad as long, pentagonal, 1.3 mm. in width. The 4 IIBr series present are 4 (3+4). The first ossicles following each axillary are basally united interiorly. The $IIBr_1$ are five times as broad as long. The $IIBr_2$ and the second brachials are distally and dorsolaterally broader.

The 14 arms are 20 mm. in length. The brachials beyond the fourth are distally everted, the eversions being armed with small spines. There are 20 brachials for each 10 mm. of arm length, or 16 if the syzygial pairs be counted as units.

Syzygies occur between brachials 3+4, 10+11, etc., and distally at intervals of 3 or 4 muscular articulations.

P_1 bears a comb composed of 8–10 large teeth; the tip of the pinnule is not smooth. P_2 is similar, somewhat shorter, 3 mm. long. P_3 is about 3 mm. long with 12 segments, and is a little swollen basally (?by a gonad). The proximal pinnules are weakly carinate. The distal pinnules are 3.5 mm. long with 12–14 segments which are stout and short, distally bearing dorsal hooks.

The disk is 5 mm. in diameter. The dorsal perisome is visible in the interspaces, about 0.5 mm. in width, between the division series. The anal tube is central.

The color is yellow brown.

Gislén remarked that this specimen is most probably referable to *Comanthus parvicirra γ vaniipinna*, represented in Mortensen's collection from Sagami Bay.

The specimen from Mortensen's station 1 was described by Gislén under the name of *Comanthus parvicirra γ vaniipinna.* The diameter of the centrodorsal is 3.2 mm.

The cirri are XVIII, 15–16, from 8 to 10 mm. long.

The radials are concealed. The IBr_1 are short and broad. The IBr_2 (axillaries) are twice as broad as long, with the distal angle produced. The IIBr and IIIBr series are 4 (3+4). The width of the $IIBr_1$ is 1.7 mm.; these ossicles are interiorly almost free from each other. The division series lie very close together.

The 21 arms are 45 mm. in length and are rather stout. There are 16 brachials to each 10 mm., or 13 if the syzygial pairs are counted as units.

The distal intersyzygial interval is 4 muscular articulations.

P_D is 11 mm. in length. The comb, which extends to the extreme tip of the pinnule, is composed of 12–13 double teeth. P_1 is 9 mm. long and bears a comb consisting of 9 teeth. P_2 is 6 mm. long; its comb has 7 teeth. P_3 bears a gonad, and is sometimes without a comb. P_4 and P_5 bear combs. P_6 and the following pinnules are without combs. The proximal portion of the distal profile of the earlier pinnules is serrate, as a result of the development of distal prominences on the segments. The gonads are large.

The disk has been thrown off and is partially regenerated. It is 11 mm. in diameter. Four of the arms have the ambulacral groove rudimentary.

The 2 specimens from Mortensen's station 2 were also referred by Gislén to *Comanthus parvicirra γ vaniipinna*. In one of these the cirri are XX, 12–14, 7 mm. long. The 33 arms are from 35 to 45 mm. in length. The IIBr and IIIBr series are 4 (3+4). P_D is 11 mm. long. The pinnules as far as P_3 or P_4 have combs consisting of a double row of 6–8 teeth. Sometimes a single pinnules in this series will be without a comb. The disk is 17 mm. in diameter. The anal tube is central, 3.5 mm. in height. The mouth is in the right anterior interradius.

In the other specimen from Mortensen's station 2 the cirri are XIX, 15–17, from 8 to 9 mm. long. The 22 arms are from 50 to 85 mm. in length. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. The 2 IIIBr series are 4 (3+4). The pinnules as far as P_4 bear combs, but P_3 is often combless. The combs are composed of 8–11 teeth in 2 rows. The disk has been thrown off, but was about 13 mm. in diameter.

The specimen from Mortensen's station 4, referred by Gislén to *Comanthus parvicirra γ vaniipinna*, has the cirri XIV, 12–15, 7 mm. long. The 19 arms are from 25 to 30 mm. in length. P_D, P_1, and P_2 bear combs and in some cases also P_4. The disk is 5 mm. in diameter. The anal tube is central, 2 mm. high. The mouth is interradial. Two of the arms are without ambulacral furrows.

The 2 specimens from Mortensen's station 23 were also referred by Gislén to *Comanthus parvicirra γ vaniipinna*. One is represented merely by some detached postradial series. The IIBr and IIIBr series are 4 (3+4). The arms are about 40 mm. long. The combs are of the usual type, with the usual distribution.

In the other the cirri have 13 segments and are 5 mm. long. The 13 arms are about 25 mm. long. Two of the division series are developed to the right and one to the left. P_1 and P_2 bear combs. The disk is 7.5 mm. in diameter. The anal tube is central.

The 3 specimens from Mortensen's station 20 were referred by Gislén to *Comanthus parvicirra α comasteripinna*.

In one of these the cirri have 11–13 segments and are 6.5 mm. in length. The arms are 21+ (probably 23) in number, from 35 to 60 mm. long. Of the 9 IIBr series present 8 are 4 (3+4) and 1 is 2. Of the 2 III Br series, 1 is 4 (3+4) and 1 is 2. Pinnules occur with combs at varying intervals as far as the twelfth. The disk is 9 mm. in diameter. The anus is central. Five or six arms are without ambulacral furrows, and on 7 more arms the pinnules of the proximal half are grooveless.

In another specimen 2 of the cirri are 6 mm. long with 12–13 segments, the remaining cirri being rudimentary. The 17+ (probably 20) arms are about 40 mm. long. The IIBr series are 4 (3+4). Combs occur here and there as far as the fifteenth pinnule. The disk is 6.5 mm. in diameter.

In the third specimen the cirri are XII, all broken. The diameter of the centrodorsal is 1.2 mm. The 13 arms are about 20 mm. long. The IIBr series are 4 (3+4), developed to the right.

Of the 5 specimens from Amoy in the Berlin Museum 1 has 15 arms about 80 mm. long; 3 have 12 arms, 95, 90, and 45 mm. long, respectively; and the fifth has 10 arms 35 mm. long.

The specimens from near the Pescadores Islands bear the manuscript name *Antedon mutabilis* Lütken.

The specimen from the Macclesfield Bank in 18–24 meters has 20 arms and the cirri II, 11. This is a slender example, with the spinosity of the brachials, pinnulars, and pinnule tips exaggerated.

Of the 2 specimens from the Macclesfield Bank in 24 meters the larger has 20 arms.

Of the 4 specimens from Macclesfield Bank in 24–66 meters, 1 has 30 arms and V cirri. Another has 21 arms and IV cirri; the 10 IIBr series are 2; the single IIIBr series, which is internally developed, is 4 (3+4). The 2 remaining have each 20 arms; 1 has VII, and the other no cirri.

Of the 4 specimens from Macclesfield Bank in 40–55 meters, one has 22, one 18, one 16, and one 14 arms; the 16-armed specimen has II cirri.

The example from the Macclesfield Bank in 47 meters has 14 arms.

The specimen from the Macclesfield Bank in 53–58 meters has 16 arms. There are no IIIBr series. There are III cirri, all situated on one semicircumference of the centrodorsal.

The example from the Macclesfield Bank in 36–64 meters has 13 arms.

The specimens from Port Galera, Mindoro, present the following characters:

The 21 arms are 160 mm. in length. While the central portion of the animal is no larger than usual, the arms are excessively elongated and attenuated. Of the 10 IIBr series, 6 are 2 and 4 are 4 (3+4). There are II nonfunctional cirri.

There are 25 arms. The centrodorsal is extremely thin and irregularly pentagonal in shape. There are II nonfunctional cirri.

Two others have, respectively, 28 arms 125 mm. long and 21 arms 70 mm. long.

Carpenter gave the characters of variety 2 of *Actinometra polymorpha* from Cabulaun (Cabulan) as follows:

The centrodorsal is small, but rather thick.

The cirri are X, 11–12. The fourth and fifth segments are the longest. The spines on the dorsal distal border begin from the middle segments, and the opposing spine is well marked.

The IBr_1 are only incompletely united. The elements of the IBr series are very convex and are much higher than the radials.

There are 29 arms.

The distal intersyzygial interval varies from 2 to 11 muscular articulations, but is usually 4.

The terminal combs are limited to the first 5 brachial pinnules and the pinnules on the division series. The pinnules of the seventh and next succeeding brachials have a dorsal keel, and the distal ends of their segments are much wider than the proximal.

The color in alcohol is grayish brown; the median dorsal line of the postradial series is marked by a white line with dark borders which is lost about the middle of the arms.

Carpenter says elsewhere that this specimen is about the same size as the type series of *polymorpha* (from Bohol), so that the arm length would be from 100 to 110 mm.

The 10 IIBr series and the 9 IIIBr series present are all 4 (3+4).

Around the margin of the centrodorsal there are only 10 cirrus sockets, 2 on each of its sides, which are placed close to the interradial angles.[9] The number of segments in each cirrus is 11 or 12. The width of the 2 basal segments somewhat exceeds their length; in the third the length and width are nearly equal, and in the fourth and fifth, which are the longest, the proportion between them is about 4 to 3. The sixth segment is slightly shorter than the fourth, and from this point to the end of the cirrus the length of the segments gradually decreases, while at the same time they exhibit a slight degree of lateral compression. The dorsal spine, the first indication of which is seen in the fifth and sixth segments, becomes very marked indeed toward the end of the cirrus, and develops on the penultimate segment into a stout opposing spine.

The position of the first 3 brachial syzygies varies as follows: Between brachials 3+4, 5+6, 7+8 (once); brachials 3+4, 11+12, 16+17 (23 times); brachials 3+4, 11+12, 18+19 (once); 3+4 11+12, 21+22 (once); 3+4, 12+13, 17+18 (once); 3+4, 13+14, 18+19 (once).

The number of muscular articulations in the first intersyzygial interval varies as follows; 1 (once); 7 (25 times); 8 (once); 9 (once).

The number of muscular articulations in the second intersyzygial interval varies as follows: 1 (once); 4 (25 times); 6 (once); 9 (once).

In the distal intersyzygial intervals the tendency is toward an increase in the number of muscular articulations over the normal, 5 occurring much more commonly than 3.

As variety 1 of *Actinometra polymorpha* Carpenter described a specimen from Ubay in the following terms:

The cirri are XXV, 13–15. The spines on the dorsal surface of the distal segments are not very distinct, but the segments are laterally compressed.

The IBr_1 are completely united.

The 20 arms are 52.5 mm. long.

The distal intersyzygial interval varies from 2 to 11 muscular articulations, but is usually 4.

Combs occur uninterruptedly as far as the sixth brachial pinnules, and then at intervals to about the twentieth brachial, but no further. The basal pinnules of the arms have a faint dorsal keel, and the distal ends of their segments are rather wider than the proximal.

The disk is about 8 mm. in diameter.

Carpenter noted that the cirri of this variety present some slight differences from those of the type series of *polymorpha*. Not only is the number of segments greater, but these latter also differ considerably in their relative proportions. While in the typical form the fifth and sixth segments are the longest, in this variety there is less difference between them and the fourth and seventh in this respect. The lateral

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[9] Vol. 1, pt. 1, fig. 176, p. 231.

compression, which is not visible until the eighth segment, becomes somewhat marked toward the end of the cirrus, which is more distinctly flattened than in the type, although the small spines on the distal dorsal margins do not appear at all until the 3 or 4 last segments, and even on these they are but slightly developed.

Carpenter said, further, that the 10 IIBr series are all 4 (3+4).

The position of the first 3 brachial syzygies varies as follows: Between brachials 3+4, 11+12, 15+16 (once); brachials 3+4, 11+12, 16+17 (10 times); 3+4, 11+12, 19+20 (3 times); 3+4, 12+13, 17+18 (4 times); 3+4, 13+14, 18+19 (once); 3+4, 15+16, 20+21 (once).

The number of muscular articulations in the first intersyzygial interval varies as follows: 7 (14 times); 8 (4 times); 9 (once); 11 (once).

The number of muscular articulations in the second intersyzygial interval varies as follows: 3 (once); 4 (16 times); 7 (3 times).

In the distal intersyzygial intervals the tendency is toward an increase in the number of muscular articulations over the normal, as in variety 2.

Carpenter said that, although this specimen is considerably smaller than the type series and the single specimen representing variety 2, he believed it to be full grown, for it has very large and well-developed gonads, while in a young and small specimen in the type series of about the same size the genital glands are scarcely developed at all.

Carpenter thus described *Actinometra polymorpha*, which was based upon 8 specimens from Bohol, and also 4 additional specimens, each of which was described as a distinct variety.

The centrodorsal is a circular or irregularly pentagonal disk with the surface flattened and slightly concave in the center which almost completely conceals the radials.

The cirri are marginal, XIV–XXV, 11–14 (usually 12–13). The fifth and sixth segments are the longest. The basal segments are thick and broader than long. The remainder taper gradually, and the terminal ones are laterally compressed. The last 5 or 6 segments have a small dorsal spine, increasing in distinctness up to the penultimate segment, which bears the terminal claw.

The radials are barely visible. The IBr_1 are short, in the mid-dorsal line of the same length as the radials but somewhat shorter laterally. They are laterally united for nearly their whole length. The IBr_2 (axillaries) are pentagonal, about twice as long as the IBr_1. The IIBr and IIIBr series are 4 (3+4).

The arms are 13–40 in number and about 100 or 110 mm. in length. The first segments following each axillary are in contact interiorly for nearly their whole length.

The first syzygy is between brachials 3+4, the next is 7 muscular articulations beyond, and the distal intersyzygial interval is from 1 to 7, but usually 4, muscular articulations.

The anterior arms are much longer than the posterior, which latter are usually without ambulacral grooves. The width of the arms increases from the fourth to the twelfth brachial, remains uniform until about the sixteenth, and then decreases, slowly in the long anterior arms and rapidly in the short posterior ones. The brachials are wedge-shaped, slightly overlapping, with the distal edges fringed with short spines.

P_D and the pinnule on the IIIBr series (when present) are long, the latter being shorter than the former. P_1 is still shorter, and the length of the succeeding pinnules gradually diminishes to those of the fifth and sixth brachials, which are the shortest on the whole arm. From the seventh brachial onward the pinnules are long and stout, gradually increasing in length and thickness to near the middle of the arm. The thickness is greatest in the short posterior arms, in which both length and thickness rapidly decrease from the middle to the end of the arm, while in the long anterior arms the thickness slowly diminishes and the length slightly increases, so that the terminal pinnules are long and slender. The last 6 or 8 segments of the pinnules of the division series and of the first 9 or 12 brachials have the outer ventral margin of each ossicle produced into a small lancet-shaped process which bends over toward the ventral side, so that the end of the pinnule has a comblike appearance. Many of the other pinnules until near the end of the arm have similar processes on their 4 or 5 terminal segments.

The disk is about 20 mm. in diameter. Small calcareous concretions are occasionally present in the neighborhood of the peristome and of the anal tube. The mouth is excentric and interradial. The posterior ambulacral grooves are very indistinct, and often nearly obliterated.

The color in alcohol is from yellowish brown to dark brown.

Carpenter said that the width of the basal cirrus segments somewhat exceeds the length, but in the second and third segments this disproportion between the length and breadth is reduced, and in the fourth it becomes reversed, the length of the fourth segment being slightly greater than its width. In the fifth and sixth segments the length is half again as great as the width, and a very slight degree of lateral compression is visible in the sixth segment, while the fifth, like the 4 preceding, is cylindrical, or nearly so. The fifth and sixth are the 2 longest segments of the cirrus, and from this point onward the length of the segments gradually decreases, until in the tenth and following segments it becomes again less than the width. At the same time the transverse diameter, which in the first 5 cylindrical segments is equal to the dorsoventral width, undergoes in the seventh and eighth a sudden decrease. A faint indication of this is seen in the sixth segment, and it is continued on to the end of the cirrus, so that its terminal portion exhibits a considerable degree of lateral compression. In correspondence with this, a small spine gradually develops on the distal dorsal margin of the sixth and following segments, on which it becomes progressively more and more marked, until on the penultimate segment it becomes a short pointed opposing spine. This series of small spines seems to be characteristic of those cirri only which have reached their full development, for scarcely any trace of them is visible in the still immature cirri.

The details of the 8 specimens considered by Carpenter as typical *polymorpha* are as follows:

There are 13 arms, the 3 IIBr series being 4 (3+4).

There are 18 arms, 4 of the IIBr series being 4 (3+4) and 4 being 2.

There are 20 arms; of the IIBr series, 5 are 4 (3+4) and 5 are 2. On one of the arms the earlier syzygies occur between brachials 5+6, 14+15, and 18+19.

There are 25 arms; all 10 of the IIBr series are 4 (3+4); of the IIIBr series, 3 are 2 and 2 are 4 (3+4).

There are 26 arms; all 10 of the IIBr series and all 6 of the IIIBr series are 4 (3+4).

There are 28 arms; of the 10 IIBr series, 7 are 4 (3+4) and 3 are 2; the 5 IIIBr series are all 4 (3+4). [This gives 25 arms instead of 28, the number ascribed to it by Carpenter.] On 4 of the arms the earlier syzygies occur between brachials 10+11, 15+16, and 20+21.

There are 28 arms; all 10 of the IIBr series are 4 (3+4); of the 8 IIIBr series, 7 are 4 (3+4) and 1 is 2.

There are 31 arms; the 10 IIBr series and the 11 IIIBr series are all 4 (3+4).

Additional details in regard to the structure of the individual arms have already been given.[10]

Carpenter pointed out that when the number of arms is unequal on the various postradial series arm division is generally carried further in the left anterior, left posterior, and right posterior radii than in the anterior and right anterior. In only four normal cases did he find one of the latter bearing more arms than one of the former. In each of these the total number of arms was considerable, and 1 at least of the 2 radii left posterior and right posterior bore the same number of arms as that in the anterior or right anterior.

In the 299 arms of these specimens (11 were broken off proximal to the fourth brachial) the first syzygy was between brachials 3+4 in 283, and the second syzygy was between brachials 11+12 in 156. The irregularities in the position of the first syzygy were limited to 3 specimens, and 10 of the 16 occurred in the specimen described as variety 4 (*timorensis*).

In the 283 arms in which the first syzygy was between brachials 3+4, excluding the 61 arms from varieties 3 and 4 (*timorensis*), Carpenter found the following variations in the position of the second and third syzygies:

Syzygies between brachials 3+4, 5+6, 7+8; in variety 2, 1 arm.

Syzygies between brachials 3+4, 6+7, 12+13; in the typical series, 2 arms.

Syzygies between brachials 3+4, 7+8, 13+14; in the typical series, 1 arm

Syzygies between brachials 3+4, 9+10, 13+14; in the typical series, 1 arm.

Syzygies between brachials 3+4, 9+10, 14+15; in the typical series, 1 arm.

Syzygies between brachials 3+4, 9+10, 15+16; in the typical series, 1 arm.

Syzygies between brachials 3+4, 9+10, 16+17; in the typical series, 1 arm.

Syzygies between brachials 3+4, 10+11, 13+14; in the typical series, 1 arm.

Syzygies between brachials 3+4, 10+11, 14+15; in the typical series, 1 arm.

Syzygies between brachials 3+4, 10+11, 15+16; in the typical series, 10 arms.

Syzygies between brachials 3+4, 10+11, 16+17; in the typical series, 1 arm.

Syzygies between brachials 3+4, 11+12, 14+15; in the typical series, 1 arm.

Syzygies between brachials 3+4, 11+12, 15+16; in the typical series, 3 arms; in variety 1, 1 arm.

Syzygies between brachials 3+4, 11+12, 16+17; in the typical series, 76 arms; in variety 1, 10 arms; in variety 2, 23 arms.

Syzygies between brachials 3+4, 11+12, 18+19; in the typical series, 1 arm; in variety 1, 1 arm.

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[10] Vol. 1, pt. 2, p. 93.

Syzygies between brachials 3 + 4, 11 + 12, 19 + 20; in variety 1, 3 arms.

Syzygies between brachials 3 + 4, 11 + 12, 21 + 22; in variety 2, 2 arms.

Syzygies between brachials 3 + 4, 12 + 13, 16 + 17; in the typical series, 3 arms.

Syzygies between brachials 3 + 4, 12 + 13, 17 + 18; in the typical series, 33 arms; in variety 1, 4 arms; in variety 2, 1 arm.

Syzygies between brachials 3 + 4, 12 + 13, 18 + 19; in the typical series, 3 arms.

Syzygies between brachials 3 + 4, 13 + 14, 16 + 17; in the typical series, 1 arm.

Syzygies between brachials 3 + 4, 13 + 14, 18 + 19; in the typical series, 30 arms; in variety 1, 1 arm; in variety 2, 1 arm.

Syzygies between brachials 3 + 4, 13 + 14, 20 + 21; in the typical series, 1 arm.

Syzygies between brachials 3 + 4, 14 + 15, 18 + 19; in the typical series, 1 arm.

Syzygies between brachials 3 + 4, 15 + 16, 20 + 21; in the typical series, 1 arm; in variety 1, 1 arm.

Carpenter pointed out that the normal position of the second syzygy is between brachials 11 + 12, and that in those cases in which it does not occupy this position it is much oftener between brachials 12 + 13 or 13 + 14 than between brachials 9 + 10 or 10 + 11; that is to say, that variation, when it occurs, is in the direction of increase rather than of decrease in the length of the first intersyzygial interval.

The number of muscular articulations in the first intersyzygial interval in typical specimens and in varieties 1 and 2 is given for 222 arms by Carpenter, as follows: 1 (once); 2 (twice); 3 (once); 5 (4 times); 6 (13 times); 7 (120 times); 8 (44 times); 9 (34 times); 10 (once); 11 (twice).

The number of muscular articulations in the second intersyzygial interval in the type series and in varieties 1 and 2 is given by Carpenter as follows: 1 (once); 2 (3 times); 3 (10 times); 4 (192 times); 5 (8 times); 6 (4 times) 7 (3 times); 9 (once).

Carpenter wrote that after the sixteenth brachial the intersyzygial interval is usually 4 muscular articulations. It is, however, very unusual to find an arm in which this interval is constant throughout its whole length and does not vary to a greater or lesser extent. In only 7 arms out of the total number which he examined did he find this to be the case, together with normal first and second intersyzygial intervals, although 23 other arms were regular from the second syzygy onward. These 30 arms were distributed among 5 of the 8 specimens in the type series, while in none of the other 3 was the intersyzygial interval constant throughout the length of any of the arms.

The same was the case with the varietal specimens. In the typical form there is a tendency to a decrease rather than to an increase in the length of the interval, which is more often 3 muscular articulations than 5, while in varieties 1 and 2 the tendency of the variation is to increase the length of the interval, 5 muscular articulations occurring much more commonly than 3.

Carpenter remarked that these conclusions are all based upon an examination of single specimens, which may in some instances be very misleading.

Carpenter said that P_1 and the pinnules on the division series are very long and slender, those on the division series being the longest, and are composed of 30–40 segments. The number of teeth in the comb varies from 10–12 on P_D to 6–8 on a brachial pinnule. In cases where P_1 is the lowest pinnule it is much longer than usual, and more of its terminal segments bear teeth.

The specimen from the reef at *Siboga* station 131 has 21 arms 100 mm. long. The 10 IIBr and the single IIIBr series present are 4 (3 + 4).

The specimen from *Siboga* station 131 in 13 meters has 20 arms about 90 mm. long. Of the 10 IIBr series 6 are 4 (3 + 4) and 4 are 2. There are III cirri.

Of the 2 specimens from *Siboga* station 133, 1 has 28 arms, and the other has 12 arms 50 mm. long.

Two of the *Challenger* specimens from Zamboanga were described by Carpenter under the name of *Actinometra rotalaria* as follows:

The centrodorsal is a small thin disk.

The cirri are about X, 10–12. None of the segments are much longer than broad.

The radials are just visible beyond the rim of the centrodorsal. The IBr_1 are closely united laterally. The IIBr series are 2. The IIIBr series are 4 (3 + 4).

The 20–30 arms are 40 mm. in length and consists of about 80 subtriangular and overlapping brachials. Some of the posterior arms may be ungrooved.

Syzygies occur between brachials 3 + 4, 11 + 12, and 16 + 17, and distally at intervals of 4 or 5 muscular articulations.

The $IIIBr_2$, when present, has a moderately long pinnule with rather stout lower segments. P_1 is nearly as long, but P_a is much smaller. P_2 and P_b are also small, but the succeeding pinnules increase considerably in both length and stoutness. The terminal comb is rather small and does not extend beyond the pinnule of the seventh brachial.

The disk is 6.5 mm. in diameter and is naked. The mouth is apparently radial.

The color in alcohol is light brownish white.

Carpenter noted that the cirri are arranged in 5 radial pairs which are placed interradially, or nearly so. He mentioned the similar arrangement in *Comatula purpurea*, but overlooked the fact that he had also described it in variety 2 of *Actinometra polymorpha*.

The figure is not entirely in accord with the description. It shows a much broken individual with 23 + arms. Of the 9 IIBr series, 6 are 2 and 3 are 4 (3 + 4). Of the 4 IIIBr series, 3 are 4 (3 + 4) and 1 is 2. He said, however, under "Remarks," that IIBr 4 (3 + 4) series occur abnormally in both his specimens, while sometimes the IIIBr series are 2 instead of 4 (3 + 4).

Of the 7 specimens from Zamboanga that he identified as *parvicirra* Carpenter said that 1 or 2 appear to approach *Actinometra quadrata*, and it may be that the latter name will have to be abandoned. In at least 6 of the 7 the arms are dimorphic. Spherodes occur in one of the specimens. In another there is a relatively large number of small and rudimentary cirri on a very thin centrodorsal. I have examined 4 of these specimens, with 33, 32, 22, and 14 arms. In the last there are V well-developed cirri which are interradial in position; in the others the cirri are much reduced or rudimentary.

Dr. Th. Mortensen's specimen from Santa Cruz Island, Zamboanga, has 20 slender arms, of which the anterior are 100 mm. and the posterior are 60 mm. in length. There are 10 IIBr 4 (3 + 4) series. The cirri are VII, 14–15. There is an unusual development of small spines on the brachials and pinnulars, so that the specimen feels more like an example of *Comanthus samoana* than like one of *C. parvicirra*.

One of the specimens from a coral reef off Jolo has 20 arms. The other is very small, with about 13 arms. The example from off Jolo in about 36–55 meters has 29 arms about 70 mm. long. Of the 10 IIBr series, 9 are 4 (3+4) and 1 is 2. Of the 9 IIIBr series, 5 are 4 (3+4) and 4 are 2. The cirri are VIII, 10–11, 5.5 mm. long, confined to the interradial angles of the centrodorsal where they occur in 3 pairs, with 2 additional occurring individually.

Some of the 21 examples from *Siboga* station 99 have the following characters:

The 28 arms are 70 mm. long. All the division series are 4 (3+4). There are V cirri.

There are 23 arms, 10 IIBr series and 3 IIIBr series being present. Of the IIIBr series, 2 are developed externally and 1 is developed internally. All the division series are 4 (3+4). There are VI cirri.

There are 20 arms.

The arms are 13 in number.

Four of the specimens have 12 arms from 20 to 35 mm. long.

Three individuals have 11 arms from 20 to 30 mm. in length; one of these is undergoing adolescent autotomy.

Nine examples have 10 arms varying from 13 to 20 mm. in length, and the lower pinnules more or less deficient.

The specimen taken at the surface at *Siboga* station 99 is very small, with 10 arms.

One of the specimens from Tataan has all the IIBr series 2.

The 2 specimens from the Jolo Archipelago in the Hamburg Museum have each some of the arms greatly lengthened and attenuated.

The examples secured at *Siboga* station 96 show the following characters:

The 25 arms are 45 mm. long. Of the IIBr series, 5 (on 3 rays) are 2 and 5 are 4 (3+4). On 1 ray 2 IIBr series of 2 each bear 2 IIIBr series. There are IV small and weak cirri.

The 22 arms are 65 mm. long. There are 3 IIBr 2 series, all the other division series being 4 (3+4). There are V small weak cirri 4 mm. long.

The 20 arms are 70 mm. long. All the IIBr series are present, and all are 4 (3+4).

The 14 arms are 25 mm. long.

There are 12 arms 30 mm. long, 13 arms 30 mm. long, and 10 arms 17 mm. long.

The example taken in plankton collecting at *Siboga* station 96 has 10 arms 17 mm. long.

The specimens from North Borneo described by Grube under the name of *Comatula mertensi* have the centrodorsal with a single row of cirri.

The cirri are XIII (XVI), 11–13. The first 3 segments are as long as broad, those following are longer than broad, and the last 4 are again as long as broad. The 3 preceding the penultimate bear a sharp dorsal tubercle, and the penultimate bears an opposing spine.

There are 2 radials, the axillary with a syzygy. [Undoubtedly this means that the radials are visible, and that the 2 elements of the IBr series are very closely united.] The IIBr series are 4 (3+4).

The 19–24 arms are about 75 mm. long. They are composed of about 100 brachials which at first are broader than long, but become gradually longer as the arms taper. The brachials have the distal border somewhat everted and overlapping.

Syzygies occur between brachials 3+4, 11+12 (or 10+11), 16+17, 21+22, 26+27, 31+32, 36+37, 41+42, 46+47, 51+52, etc.

P_D is longer than the following pinnules. After a little the length of the pinnules increases again. The pinnules have about 16 segments.

Carpenter examined Grube's types and found their characters to be in all respects those of *parvicirra*.

The 28 specimens from *Siboga* station 79*b* show the following characters. In all of them the cirri are small and weak and irregular in distribution.

The arms are 70 mm. long.

There are 20 arms and VI cirri.

There are 18 arms, one ray lacking IIBr series, 65 mm. long. The cirri are V.

There are 18 arms 60 mm. long and IV cirri.

There are 16 arms 55 mm. long and 1 small cirrus stump.

There are 16 arms 55 mm. long and VI cirri.

There are 15 arms 60 mm. long and no cirri.

There are 15 arms 60 mm. long and V cirri.

There are 14 arms 55 mm. long and 1 small cirrus stump.

There are 14 arms 60 mm. long and IV rudimentary cirri.

There are 14 arms 60 mm. long and V cirri.

There are 15 arms 60 mm. long and 1 rudimentary cirrus.

There are 12 arms 50 mm. long and I cirrus.

There are 11 arms 55 mm. long and I cirrus.

There are 11 arms 30 mm. long and III cirri.

There are 10 arms 50 mm. long and VII cirri.

There are 10 arms 45 mm. long and IV cirri.

The remaining specimens are similar.

The specimens from *Siboga* station 78 are characterized by a slender habitus, few, small, and weak cirri, strongly marked "dryness," or an unusual development of small spines on the pinnule segments and the distal edges of the brachials, and a strong tendency to break at the articulation between the elements of the IBr series. It is quite possible that these features are due, in part at least, to some peculiarity of the fluid in which they happened to be preserved which induced an unusual amount of shrinkage of the organic substance. They show the following features:

There are 20 arms 60 mm. long. Of the 10 IIBr series, 8 are 4 (3+4) and 2 are 2. There are IV small cirri.

There are 18 arms 65 mm. long. Of the 8 IIBr series, 6 are 4 (3+4) and 2 are 2. There is I cirrus.

There are 18 arms 45 mm. long. Eight IIBr 4 (3+4) series are present. There are III cirri.

There are 17 arms 60 mm. long. Of the 7 IIBr series, 4 are 2 and 3 are 4 (3+4). There are IV small cirri, 4.5 mm. in length.

There are 13 arms 55 mm. long. Of the 3 IIBr series, 2 are 2 and 1 is 4 (3+4). There are III small cirri.

The remaining 10 specimens are similar to these.

The example from *Siboga* station 81 is small, with 16 arms 70 mm. long.

The type specimen of *Alecto parvicirra* was without locality. The species was described by Müller from a specimen in the Paris Museum on the basis of notes taken for him by Troschel. As the description published by Müller in 1849 is identical with the original description published in 1841, there is no evidence that Müller reexamined the specimen on his visit to Paris. Dujardin seems not to have found it in the Paris Museum collection, for he said in 1862 that the type was recorded by Müller as in the Paris Museum. Neither Carpenter, who searched twice for it, nor I have been able to find it. The characters as given by Müller are as follows:

The cirri are XX+, 12, very slender and short.

The radials are visible. The IIBr series are 4 (3+4). The IIIBr series, when developed, are 4 (3+4).

The 27 arms are 82.25 mm. long.

Syzygies occur between brachials 3+4, 10+11, or 11+12, and distally at intervals of 3–5 muscular articulations.

The pinnules are almost uniform.

The 2 specimens without locality collected by the *Gazelle* have each apparently 20 arms. In 1 of them 8 of the IIBr series are 4 (3+4) and 2 are 2, and in the other 6 of the IIBr series are 2 are 4 are 4 (3+4). In both the centrodorsal is much reduced, with only 1 or 2 rudimentary cirri remaining.

Regarding the terminal portion of the arms in this species, Dr. Torsten Gislén wrote in 1924 that in *parvicirra* and in *Comatula pectinata* the anterior arms end as described for *Antedon petasus* by Mortensen in 1920 (see Part 3)—the main arm always keeps its character of a main branch and the pinnules arise as small buds alternately to the right and left. On the posterior arms the only difference is that the growth of the main arm is retarded so that the pinnules reach the full size, while the main arm grows not at all, or only slowly. Therefore the arm does not end in an axillary supporting 2 pinnules, but on the last segment that gives rise to a ramification there is an (almost) full grown pinnule and a main arm composed of a few brachials. As soon as more than 1 or 2 segments have been formed on the main arm a new pinnule develops. The main arm, therefore, keeps its ramified character and never develops as a pinnule.

Abnormal specimens.—In 1 of the specimens from Moreton Bay, Queensland, 1 of the IBr series is 6 (5+6).

In 1 of the specimens collected by Professor Semper at Bohol and described by Carpenter (as *Actinometra polymorpha*), 1 of the IIIBr series is 1; this bears, next to the median line of the ray, a IVBr 2 series.

A detached arm fragment from 1 of the 2 specimens without locality collected by the *Gazelle* exhibits a peculiar case of distal arm division. The pinnule socket of one of the brachials, instead of bearing a pinnule as usual, bears a perfect arm which is slightly smaller than the main trunk and extends outward from the latter in the same plane as the pinnules arising on the same side from the normal brachials. The first and second brachials of this supernumerary arm bear pinnules, and syzygies occur between brachials 3+4, 8+9, and 13+14.

In 1 of the specimens collected by the *Challenger* at Zamboanga, 1 of the IBr_1 is absent, so that the IBr axillary rests directly on the radial. Of the 2 IIBr series borne by this axillary, 1 similarly consists of a single axillary ossicle, and the other is 2. The other 8 IIBr series are all 4 (3+4); all of the IIIBr series and the single IVBr series, which is on the outermost side of a ray, are 4 (3+4). There are 32+ arms. The centrodorsal is pentagonal with irregular sides and apparently bears II interradial cirri.

In a specimen with 16 arms from the Danish expedition to the Kei Islands station 20, one of the IBr axillaries is represented by 2 ossicles situated side by side, with their distal borders making an obtuse angle with each other. The dividing line runs from just to the left of the angle proximally and to the right to a point one-third of the distance from the right to the left side of the distal border of the IBr_1. Where this line reaches the distal border of the IBr_1 there is a prominent triangular area, and just to the left another in contact with it, these representing rudimentary segments. Each of these elements into which the IBr axillary is divided is followed by a syzygial pair, of which the epizygal is axillary.

Remarks.—The true status of the assemblage of more or less widely varying types here considered as the species *Comanthus parvicirra* is as yet undetermined.

The line of delimitation between *parvicirra* and *timorensis* as here drawn is not sharply defined, and, as may be seen from the notes on the specimens of both of these, many intermediates occur. Yet the line seems really to exist, for the vast majority of specimens fall readily on one side or the other.

It is worthy of special note that while the small form, *parvicirra,* is excessively variable, the large, *timorensis,* is relatively stable, being only slightly variable in all the several features wherein the other is remarkably inconstant.

The form here called *timorensis* is confined within the area from Ceylon to tropical Australia, Tonga, Fiji, and the Philippines, while *parvicirra* occurs far beyond these limits. Yet the specimens of *parvicirra* from the limits of its range seem to be identical with those taken within the area occupied by *timorensis.*

As the young of comasterids always have slender arms, no matter how stout these may become in later life, and as all the species with very numerous arms sometimes are found with an arm number far below the average (as, for instance, *Comatella nigra,* p. 95), it may be that some of the individuals here assigned to *parvicirra* are in reality slender individuals of *timorensis* with a reduced number of arms.

In both *timorensis* and *parvicirra* the cirri are extremely variable, but usually few and more or less undeveloped, sometimes confined to the interradial angles of the centrodorsal, and occasionally wholly absent. In *timorensis* the number of cirrus segments is somewhat greater than in *parvicirra,* a difference which appears to be proportionate to the difference in size of the individuals. In *timorensis* they are much more commonly greatly reduced or absent altogether than is the case in *parvicirra,* and also they are much more uniform in structure.

In *parvicirra* individuals are sometimes found with the cirri more numerous, better developed, and stouter than usual, and through such individuals there is a more or less complete intergradation with *samoana.*

The eversion of the distal edges of the brachials and the relative development of spines on the edges and the dorsal surface of the brachials and pinnule segments varies considerably in *timorensis*, and very greatly in *parvicirra*. In these features the latter also intergrades with *samoana*.

The curious specimen of *parvicirra* from Cape Baudin, with the elements of the division series bluntly carinate and with swollen edges, has no counterpart in any of the other species of Comasteridae.

The division series in both *timorensis* and *parvicirra* are highly variable in the relative proportion of series of 4 (3+4) and of 2; but they are never, except as a very rare abnormality, irregular. The IIBr series in both may be all 4 (3+4), or they may be all 2, or the 2 types may occur together in any proportion. Generally speaking, the IIBr 4 (3+4) series are in the majority. The same is true of the IIIBr series. While individuals with a large number of IIIBr series all of which are 2 are very rare, such have been recorded, and these approach closely certain of the more generalized species of *Comantheria*.

Thus Dr. H. L. Clark has described as *callipeplum*, which he said is nearly related to *Comantheria briareus*, a specimen which, after examination, seems to me to be nothing but an unusually fine example of *timorensis*.

In *timorensis* the synarthrial articulations may always be identified as such, but the closeness of the synarthrial unions in *parvicirra* varies very greatly, so that certain individuals are easily mistaken for one or other of the small species of *Comaster*. Indeed, I am not sure but that in *parvicirra* the proximal synarthries are not sometimes more or less completely transformed into syzygies, and that therefore the main differential character between *Comaster* and *Comanthus*, which serves to distinguish at a glance the larger species of these genera, is not subject to a certain amount of intergradation in the smaller forms.

Carpenter called attention to the extraordinary variation in the combs on the oral pinnules in 1879. In the series of specimens which he described as *polymorpha* he said that the last 6 or 8 segments of the pinnules on the division series and the first 8 or 10 brachials have the outer ventral margin of each calcareous segment produced into a small lancet-shaped process which bends over toward the ventral side, so that the end of the pinnule has a comblike appearance. Many of the other pinnules until near the end of the arm have similar processes upon their 4 or 5 terminal segments. There is a possibility that this last observation may have been based upon an unrecognized specimen of one of the small species of *Comaster*, but of this there is no clear evidence.

In variety 1 of *polymorpha* from Ubay combs occur regularly as far as the sixth brachial pinnule, and thence at intervals to about the twentieth brachial, but no further. The cirri as described for this variety are very unusual for *parvicirra*, and it would seem as if the specimen might have been an example of *Comaster tenella;* but the distribution of the syzygies does not support this view.

In variety 2 from Cabulaun the comb is limited to the pinnules of the division series and the first 5 brachial pinnules.

In variety 3 from Bohol (*timorensis*) the comb occurs on the pinnules of the division series, on P_1, and occasionally on the pinnules of the fourth-sixth brachials, but on no others.

In variety 4 from Ubay (*timorensis*) the combs are found on the pinnules of the division series, P_1 and P_a, and the processes forming them gradually cross over and come to rise from the ventral (nearest the arm) surface of the calcareous segments instead of from their outer margins.

According to Carpenter the combs consist of from 10 to 12 teeth on a pinnule on the IIBr series, this number decreasing to 6–8 teeth on a brachial pinnule.

The forms described by Carpenter in 1888 and herein assigned to *timorensis* or to *parvicirra* have combs as follows:

In *elongata* the first 6 or 8 pinnules have a slight terminal comb which occurs at intervals to far out on the arm.

In *simplex* the first 4 pinnules on each side have a small terminal comb which is found at intervals until near the end of the arms.

In *rotalaria* (from Zamboanga in 18 meters) the terminal comb is rather small and does not extend beyond the seventh brachial.

In *quadrata* there is a terminal comb on the pinnules of the first 9 brachials, and thence irregularly until the twentieth.

In his final description of *parvicirra* (1888) Carpenter said that the terminal comb varies very much is size, being sometimes quite small and inconspicuous. It may not extend beyond the pinnule of the fourth brachial, or it may occur on all the pinnules to the twelfth, and at intervals to the twenty-fifth, occasionally even to near the end of the arm.

In *valida* (*timorensis*) as described by Carpenter the terminal comb is small and much obscured by perisome.

In *littoralis* (*timorensis*) the proximal pinnules have a well-defined comb which disappears by the fifth or sixth brachial.

Carpenter figured 3 variations of the comb in as many different individuals from Zamboanga. In one, as he said, the comb is so small that it might easily escape notice. It seems from the figure to be composed of about 4 teeth. In the next it is larger, with 5 well-developed teeth. In the third it is still larger, with 8 still more developed teeth.

Dr. H. L. Clark wrote (1921) that he is by no means sure that *parvicirra* and *timorensis* (*annulata*) ought to be regarded as distinct, but, on the other hand, it seemed to him unwise to include them both under a single name. He noted that many specimens of *timorensis* have only from 21 to 29 arms and often have cirri, sometimes XVIII or XIX, so that it is only by a careful weighing of all the characters that the 2 species can be distinguished. Doctor Clark believed that, aside from the matter of color, *parvicirra* is distinguishable from *timorensis* by its lighter and more fragile structure, by the presence of some cirri, and by the relatively small number of arms. He concluded that perhaps further observations on living specimens may reveal a more natural line of division than is at present known.

The habitus of *parvicirra* is much more variable than that of *timorensis;* while the individuals are always small with relatively few arms, they are often robust. The cirri as a rule are more numerous and better developed than in *timorensis*, but they are often few, and occasionally wholly lacking.

Gislén in 1922 divided *parvicirra* into 3 "subspecies," α *comasteripinna*, β *comanthipinna*, and γ *vanipinna*. He did not formally diagnose these forms, but in the notes on the specimens assigned to *comasteripinna* he said that the combs on the proximal pinnules have 8–11 teeth and occur beyond the oral pinnules on about every alternate pinnule, or irregularly, as far as the twelfth, fifteenth, twenty-fifth, or thirtieth, while in the specimens assigned to *comanthipinna* the comb consists of about 12 low thin teeth and does not extend beyond P_2. In *vanipinna*, as given in 1927, the combs consist of 6–8, 8–11, or 12–13 large teeth in a double row which extend to the extreme tip of the pinnule and occur as far as P_4 or P_5, P_3 being often without a comb.

He said that *comanthipinna* has stouter arm bases than *comasteripinna* and somewhat longer branchials, but remarked that it was chiefly the different appearance of the combs that caused him to separate the 2 types and to designate them by different names.

Gislén regarded the separation of *timorensis* and *parvicirra* as based on the number of arms to be artificial and remarked that the facts of the matter are undoubtedly that *timorensis* (*annulata*) represents one group of forms with a generally greater number of arms which are longer and stouter, while *parvicirra* represents another with a smaller number of more slender arms. Nevertheless, he said, both the "species" vary so considerably that they often intrude upon each other's spheres.

He wrote that the specimens obtained by Doctor Bock show that within the subgenus *Comanthus* (*Vania*) there occur combs of what he described as the *Comaster* and *Comanthus* types, and he found in Mortensen's Japanese specimens combs of the *Vania* type in addition.

He placed Bock's specimens in 2 "subspecies" (*comasteripinna* and *comanthipinna*), according to the type of comb. He said that he had been neither able nor willing to discuss the innumerable synonyms of this species (*parvicirra*), and that it is not possible to distribute the names among the 2 new subspecies because most of the authors have given no information about the occurrence and appearance of the combs, and that even the present author "who has described hundreds of specimens belonging to this species," has hardly given any other information than about cirri and division series. He inferred that it was therefore only natural that I had escaped making the observation that a comb of the *Comaster* type also occurs in the subgenus *Comanthus* (*Vania*).

He recalled that in his report on Mjöberg's crinoids (1919) he recorded Carpenter's statement concerning the occurrence of the *Comaster* type of comb in 3 of the described forms which I had placed in the synonymy of *parvicirra* (*elongata*, *simplex*, and *quadrata*).

As all the specimens in Mjöberg's collection had 4 components in the IIBr series and were *Comaster*-like in respect to the distribution of the combs, he, trusting to my generic diagnoses, assigned the specimens to the genus *Comaster*, those with stouter cirri to *Comaster multifida* and those with rudimentary cirri to *C. typica*, whereas they should (according to him) have been assigned to *Comanthus parvicirra*.

He said that since then he had established the fact that the occurrence of combs far out on the arms is not exclusively a feature of the genus *Comaster*, but is found in the subgenus *Comanthus*.

The keys which I have heretofore published to the genera of the Comasterinae have not been wholly satisfactory. This has been in part due to an exaggeration of the importance of the occurrence of combs on the middle and distal pinnules in the genus *Comaster*. While it seems to reach its maximum in the species of this group, it is nevertheless equally characteristic of certain species, and of certain individuals in other species, in *Comanthina* and *Comantheria*, and, as shown by Carpenter long ago, of a large proportion of the individuals in *Comanthus parvicirra*, although not found in the very closely related *C. timorensis*.

Gislén has fallen into the same error in emphasizing the number and structure of the combs in *parvicirra*.

It was by following my somewhat misleading keys and diagnoses that he was led to identify Mjöberg's specimens as *Comaster multifida* and *C. typica*, but it was through exaggerating the importance of his discoveries based on Bock's specimens of *parvicirra* that he was later led to redetermining these same specimens as that species, whereas one of them was a typical example of *Comantheria rotula* and another an example of *Capillaster multiradiata*.

Gislén said that it is not strange that both *timorensis* and *parvicirra* have caused all authors great trouble by the extreme variability in practically all differential characters elsewhere successfully employed. Not only are the cirri and cirrus segments, division series, and brachials very variable in appearance and number, but there is added to this the varying development and distribution of the combs.

He said that it is possible that the species *timorensis* and *parvicirra* have become a dumping ground for divers species difficult of solution or types inconvenient for the systematist. A full discussion of his remarks has already been given (p. 407).

Localities.—Cape St. André, Madagascar; about 30 meters; Dr. P. R. Joly, 1901 [A. H. Clark, 1911, 1912] (2, U.S.N.M., 34944; P. M.). Pl. 80, fig. 218.

Seychelles; 62 meters [A. H. Clark, 1913] (2, B. M.).

Mauritius [A. H. Clark, 1911, 1912, 1913] (2, B. M.).

Investigator; Gwada, Baluchistan [A. H. Clark, 1912] (2, U.S.N.M., 34961, 34986).

?India (probably Ceylon) [A. H. Clark, 1912] (1, I. M.).

Investigator; Galle, Ceylon [A. H. Clark, 1912] (7, U.S.N.M., 34977, 34979, 34981, 34998, 35008, 35025; I. M.). Pl. 78, figs. 209, 210.

Ceylon Pearl Oyster Fisheries station XLVI; western coast of Ceylon; from off Mount Lavinia northward to off Colombo, from 7 to 12 miles off shore; 46–55 meters; bottom, nullipore balls (*Lithothamnion fruticulosum*), coral fragments, and some *Orbitolites* sand [Chadwick, 1904; A. H. Clark, 1912].

Ceylon Pearl Oyster Fisheries station LXIX; western coast of Ceylon; on and to the east of the north end of Chilaw Paar; 15–20 meters; bottom, yellow quartz sand, with some coral fragments; yellow algae with oyster spat [Chadwick, 1904; A. H. Clark, 1912].

Ceylon Pearl Oyster Fisheries station IX; Gulf of Manaar; on the southwestern corner of West Cheval Paar, about 12 miles from land; 13 meters; bottom, fine quartz gravel, nullipore concretions, and many dead young pearl oyster shells; temperature, 25.56° C.; specific gravity, 1.023 [Chadwick, 1904; A. H. Clark, 1912].

Ceylon Pearl Oyster Fisheries station LIV; Gulf of Manaar; in the northern part of the Gulf of Manaar, south of Adams Bridge; 7–73 meters; bottom varied, from sand to living coral [Chadwick, 1904; A. H. Clark, 1912].

Ceylon Pearl Oyster Fisheries station LVII; Gulf of Manaar; outside Dutch Moderagam Paar; 21–66 meters; bottom, *Orbitolites* sand, nullipores, and dead corals [Chadwick, 1904; A. H. Clark, 1912].

Ceylon Pearl Oyster Fisheries station LXIII; Gulf of Manaar; to the west of Periya Paar, going south; 31–100 meters; bottom, *Orbitolites* sand, some dead coral, shells, and pieces of nullipore [Chadwick, 1904; A.H. Clark, 1912].

Ceylon [Chadwick, 1904; A. H. Clark, 1913] (1, B. M.).

Gulf of Manaar; littoral [Thurston, 1894: A. H. Clark, 1912].

Ceylon [Bell, 1887; P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (2, B. M.). Same; Doctor Sarasin [Reichensperger, 1913]. Same [H. L. Clark, 1915].

Tuticorin, Madras [Bell, 1888; Thurston, 1894; A. H. Clark, 1912]. Same, on stems of gorgonians [Thurston, 1894; A. H. Clark, 1912].

Madras [Bell, 1888; Thurston, 1894; A. H. Clark, 1912, 1913] (2, B. M.).

Bay of Bengal (refers to the records from Madras) [Bell, 1888; A. H. Clark, 1912].

Investigator; off Contors Island, Mergui Archipelago (lat. 12° 12′ N., long. 98° 15′ E.); 15 meters [A. H. Clark, 1912] (1, U.S.N.M., 34083).

Investigator station 7; off the northern coast of Table Island, Coco group (north of the Andamans); 27–64 meters; coral; December 8, 1888 [A. H. Clark, 1912] (1, U.S.N.M., 35006).

Investigator; Andamans; surf line [A. H. Clark, 1912] (1, I. M.).

Investigator; Andamans [A. H. Clark, 1912] (3, U.S.N.M., 35029, 35065; I. M.).

Nicobar Islands; *Galathea* Expedition [P. H. Carpenter, 1888; A. H. Clark, 1909, 1912] (2, C. M.). Pl. 29, fig. 88; pl. 65, fig. 184.

Singapore; Consul Svend Gad; June 17, 1904 (1); June 15, 1905 (6); April 20, 1906 (12); December 12, 1906 (1); April 16, 1907 (4); November 27, 1907 (8); January 9, 1908 (12); October 23, 1910 (1); [A. H. Clark, 1909, 1912] (45, U.S.N.M., 34996; C. M.). Pl. 79, fig. 212.

Sumatra; O. Hagerup, 1917 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; Sebesi Strait, between Sumatra and Java; under stones in shallow water; July 31, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 74; Sunda Straits, between Sumatra and Java; 30 meters; stones and shells; July 29, 1922 (1).

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 104; Java Sea, off western Java (lat. 5° 52′ S., long. 106° 04′ 05″ E.); 38 meters; stones and sponges; August 4, 1922 (1).

Siboga station 315; anchorage east of Sailus Besar, Paternoster Islands (north of Sumbava); coral reef; February 17–18, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 40; anchorage off Pulu Kawassang, Paternoster Islands; coral reef; April 2, 1899 [A. H. Clark, 1918] (2, U.S.N.M., E. 392).

Siboga station 43; anchorage off Pulu Sarassa, Postillon Islands, between Celebes and Sumbava; down to 36 meters; coral: April 4–5, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 310; off southeastern Sumbava (lat. 8° 30′ 00″ S., long. 119° 07′ 30″ E.); 73 meters; sand, with a few pieces of dead coral; February 12, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga; Maumeri, Flores; coral reef [A. H. Clark, 1918] (2, Amsterdam Mus.).

Solor (east of Flores); Doctor Semmelink [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911, 1912] (2, L. M.).

Siboga station 58; anchorage off Seba, Savu (between Sumba and Timor); reef; April 25, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 60; Haingsisi, Samau Island, Timor; reef; April 27–28, 1899 [A. H. Clark, 1918] (13, U.S.N.M., E. 484; Amsterdam Mus.).

Siboga station 303; Haingsisi, Samau Island (west of southwestern Timor); reef; February 2–5, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 294; south of western Timor (lat. 10° 12′ 12″ S., long. 124° 27′ 18″ E.); 73 meters; soft mud, with very fine sand; January 23, 1900 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Atapupu, Timor; Prof. E. von Martens [P. H. Carpenter, 1881; A. H. Clark, 1912] (2, Berl. M., 1647).

Kupang, Timor; Prof. E. von Martens [P. H. Carpenter, 1881].

Siboga station 282; anchorage between Nusi Besi and the northeastern point of Timor (lat. 8° 25′ 12″ S., long. 127° 18′ 24″ E.); 27–54 meters; sand, coral, and lithothamnion; January 15–17, 1900 [A. H. Clark, 1918] (6, Amsterdam Mus.).

Siboga station 144; anchorage north of Salomakiëe (Damar) Island; reef; August 1899 [A. H. Clark, 1918] (3, Amsterdam Mus.).

Challenger; Banda; 31 meters [P. H. Carpenter, 1888; A. H. Clark, 1912].

Challenger; Banda [P. H. Carpenter, 1879, 1888; A. H. Clark, 1912, 1913] (2, B. M.).

Siboga station 240; Banda; reef, and 9–36 meters; November 22–December 1, 1899 [A. H. Clark, 1918] (2, U.S.N.M., E. 416; Amsterdam Mus.).

Danish expedition to the Kei Islands: Dr. Th. Mortensen; off Neira, Banda; about 20 meters; sand; June 10, 1922 (7); about 100–200 meters; sand and stones; June 5, 1922 (1).

Amboina; Dr. J. Brock [Hartlaub, 1891; A. H. Clark, 1912; Hartmeyer, 1916] (1, Berl. M., 5284 [5248]).

Amboina; Professor Strubell [Reichensperger, 1913].

Amboina [Döderlein, 1898; A. H. Clark, 1912].

Amboina; MM. Maurice Bedot and C. Pictet [Koehler, 1895; A. H. Clark, 1912].

South coast of Ceram; Hoedt [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911, 1912] (1, L. M.).

Siboga station 172; anchorage between Gisser and Ceram Laut (off southeastern Ceram); 18 meters; coral and lithothamnion; August 26–28, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 234; Nalahia Bay, Nusa Laut Island; 46 meters; November 19–20, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger; Ternate [P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (1, B. M.).

Ternate [Pfeffer, 1900; A. H. Clark, 1912] (1, H. M.).

Moluccas (refers to all the records from the Moluccas) [A. H. Clark, 1912].

Danish expedition to the Kei Islands; Dr. Th. Mortensen; station 15; about 5 meters; sand and lithothamnion; April 10, 1922 (1); station 20; about 50 meters; sand and shells; April 14, 1922 (5) [pl. 80, figs. 215, 216]; station 30; 40 meters; sand and shells; April 18, 1922 (2). Pl. 79, fig. 211.

Siboga station 273; anchorage off Pulu Jedan, eastern coast of the Aru Islands; pearl banks; 13 meters; sand and shells; December 23–26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Siboga station 162; western coast of Salawatti (west of New Guinea), between Loslos and Broken Islands; 18 meters; coarse and fine sand, with clay and shells; August 18, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Fremantle, Western Australia [A. H. Clark, 1911, 1912, 1913] (1, B. M.).

Endeavour; between Fremantle and Geraldton, Western Australia [A. H. Clark, 1914] (1, W. A. M.).

Wooded Isle, Abrolhos Islands (Houtmans Rocks), Western Australia [H. L. Clark, 1923] (7, W. A. M.)

Cape Baudin, Australia; Péron and Lesueur [A. H. Clark, 1911, 1912] (1, P. M.). Baudin Island [A. H. Clark, 1911] refers to the same specimen.

Mjöberg's station 5; Cape Jaubert, Western Australia, 42 miles westsouthwest; 13 meters; July 5, 1911 [Gislén, 1919, 1922].

Bassett-Smith bank; 16 meters [A. H. Clark, 1912, 1913] (2, B. M.).

Northwest Australia [A. H. Clark, 1911, 1912]. This refers to the preceding record.

Mer, Murray Islands, Torres Strait; southwest reef; H. L. Clark, October 3, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 545). Same, October 14, 1913 [H. L. Clark, 1915, 1921] (fragments, M. C. Z., 546).

Mer, Murray Islands; south flat; H. L. Clark, September 25, 1913 [H. L. Clark, 1915, 1921] (1, M. C. Z., 584).

Mer, Murray Islands; H. L. Clark, October 1913 [H. L. Clark, 1915, 1921] (19, M. C. Z., 543, 547, 582, 583).

Mer, Murray Islands; H. L. Clark, 1913 [H. L. Clark, 1915, 1921] (3, M. C. Z., 544, 581).

Alert; Warrior Reef, Torres Strait [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (1, B. M.).

Thursday Island [A. H. Clark, 1912].

Challenger station 186; Prince of Wales Channel, Torres Strait (lat. 10° 30′ S., long. 142° 18′ E.); 15 meters; coral mud; September 3, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (2, B. M.).

Torres Strait; Prof. J. Beete Jukes; H. M. S. *Fly*, 1843–1847 [A. H. Clark, 1913] (2, B. M.).

Port Denison, Queensland [A. H. Clark, 1912].

Alert; Port Molle, Queensland [Bell, 1884; P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (2, B. M.).

Port Molle, Queensland [A. H. Clark, 1911] (2, Austr. M.).

Moreton Bay, Queensland [P. H. Carpenter, 1888 (as Moreton Bay, Fiji); Hartlaub, 1891; A. H. Clark, 1912] (3, H. M.).

Australian seas; MM. Péron and Lesueur, 1803 [P. H. Carpenter, 1881, 1888; A. H. Clark, 1911, 1912] (3, U.S.N.M., 34987; P. M.).

Friedrich-Wilhelms-Haven, New Guinea; Herr H. Schöde [A. H. Clark, 1912; Hartmeyer, 1916] (3, Berl. M., 5944).

Challenger; Admiralty Islands, Bismarck Archipelago; 29–36 meters; [P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (2, B. M.).

Challenger; Admiralty Islands; 29–46 meters [P. H. Carpenter, 1879, 1888] (1, B. M.).

Pitilu, Admiralty Islands; Dr. G. Duncker, October 12–13, 1908 [A. H. Clark, 1912] (1, H. M.). Pl. 81, fig. 221.

Ekalin, St. Matthias Island, Bismarck Archipelago; shore and reefs [A. H. Clark, 1912] (1, H. M.).

New Caledonia; 1886 [A. H. Clark, 1911, 1912] (1, P. M.).

New Hebrides [A. H. Clark, 1911] (1, Austr. M.).

Sandal Bay, Lifu, Loyalty Islands; Prof. Arthur Willey [Bell, 1899; A. H. Clark, 1912].

Tonga and Fiji [A. H. Clark, 1912] (1, H. M.).

Challenger station 174, B, C or D; near Kandavu, Fiji (lat. about 19° 06′ S., long. about 178° 18′ E.); 466, 383, or 1,115 meters; coral mud; August 3, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1912]. The specimen could not have come from any of the depths indicated; it was probably taken in shore collecting.

Ovalao, Fiji; Herr Arkona [A. H. Clark, 1912] (1, Berl. M., 2405).

Swan Point, Vanua Mbalavu, Fiji; Alexander Agassiz, November 25, 1897 (1, M. C. Z., 36).

Suva Reef, Viti Levu, Fiji; Alexander Agassiz, December 12, 1897 (3, M. C. Z., 198, 203, 204).

Fiji [Lütken, 1874, 1877; P. H. Carpenter, 1888; Hartlaub, 1891; A. H. Clark, 1912].

Vavao, Tonga (Friendly) Islands; MM. Hombron and Jacquinot, 1841; *Astrolabe* [J. Müller, 1849; P. H. Carpenter, 1879, 1888; A. H. Clark, 1911, 1912] (1, P. M.).

Challenger; Tongatabu Reefs [P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (1, B. M.).

Tonga Islands; Godeffroy Museum, 1871 [Lütken, 1874, 1877; A. H. Clark, 1909, 1912] (2, C. M.). Pl. 73, fig. 200.

Tonga Islands [von Graff, 1884].

Samoa [A. H. Clark, 1912].

Gilbert (Kingsmill) Islands [P. H. Carpenter, 1888; Hartlaub, 1912; A. H. Clark, 1912].

Ponapé, Caroline Islands [Hartlaub, 1891 (as Panope); A. H. Clark, 1912 (as Panopé, New Guinea)].

Pelew Islands [A. H. Clark, 1912].

Dr. Sixten Bock's expedition to Japan station 49; Bonin Islands, in the Channel; 64 meters; August 2, 1914 [Gislén, 1922].

Dr. Sixten Bock's expedition to Japan station 40; Bonin Islands; Taki Ura; diver; coral bottom; July 28, 1914 [Gislén, 1922].

Lot's Wife's Rock (north of the Bonin Islands, about lat. 30° N.) bearing NE. ¾ E. (true), 1.1 miles distant; U. S. S. *Alert*, June 27, 1880 (2).

Tokyo (Yeddo) Bay, Japan; Prof. Edward S. Morse [P. H. Carpenter, 1881, 1888; Hartlaub, 1912; A. H. Clark, 1912] (14, U.S.N.M., 34968; M. C. Z., 35, 202).

Dr. Sixten Bock's expedition to Japan station 63; Misaki, Sagami Bay, Japan; shore at low tide; September 14, 1914 [Gislén, 1922].

Misaki; Prof. Bashford Dean (1, U.S.N.M., 36138).

Mortensen's station 1; Misaki Biological Station; on the shore; April 23, 1914 [Gislén, 1927].

Mortensen's station 2; Misaki; shore; April 1914 [Gislén, 1927].

Mortensen's station 4; Misaki; shore; May, 1914 [Gislén, 1927].

Mortensen's station 23; Misaki; on roots of *Laminaria;* 1.8–3.6 meters; June 16, 1914 [Gislén, 1927].

Mortensen's sation 20; Okinose, Sagami Bay; 110 meters; hard bottom; June 11, 1914 [Gislén, 1927].

Sagami Bay; Dr. Th. Mortensen [Gislén, 1922]. This refers to the 5 preceding stations.

Southern Japan [A. H. Clark, 1912]. This refers to Professor Morse's specimens from Tokyo Bay.

Amoy, China, Consul Robert Swinhoe [A. H. Clark, 1913] (28, B. M.).

Amoy [A. H. Clark, 1912] (5, U.S.N.M., 34988; Berl. M., 5352).

Near the Pescadores Islands, west of Formosa (lat. 23° 20′ N., long. 118° 30′ E.); 31 meters; Andrea, 1869 [von Graff, 1884 (longitude given as 118° 30′ and also as 118° 38′ E.); A. H. Clark, 1909] (10, C. M.).

Formosa (Taiwan) [A. H. Clark, 1912]. This refers to the preceding record.

China Sea [P. H. Carpenter, 1888; A. H. Clark, 1909, 1912] (3, C. M.).

Macclesfield Bank; 18–24 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.). Same; 24 meters [Bell, 1894; A. H. Clark, 1913] (2, B. M.). Same; 24–66 meters [Bell, 1894; A. H. Clark, 1913] (4, B. M.). Same; 40–55 meters [Bell, 1894; A. H. Clark, 1913] (4, B. M.). Same; 47 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.). Same; 53–58 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.). Same; 36–64 meters [Bell, 1894; A. H. Clark, 1913] (1, B. M.).

Macclesfield Bank [A. H. Clark, 1912]. This refers to the preceding records.

Albatross station 5109; China Sea, off southern Luzon; Corregidor Light bearing N. 42° E., 25.8 miles distant (lat. 14° 03′ 45″ N., long. 120° 16′ 30″ E.); 18–22 meters; coral; January 15, 1908 (2, U.S.N.M., 35945).

Port Galera, Mindoro, Philippines; Dr. Laurence E. Griffin (5, M. C. Z., 616, 664, 674, 676).

Cabulaun (northeast of Palawan), Philippines; Prof. Carl Semper [P. H. Carpenter, 1879, 1888; A. H. Clark, 1912].

Albatross station 5218; between Burias and Luzon; Anima Sola Island (E.) bearing N. 10° W., 2 miles distant (lat. 13° 11′ 15″ N., long. 123° 02′ 45″ E.); 36

meters; coarse sand; April 22, 1908 [A. H. Clark, 1909, 1912] (2, U.S.N.M., 35005, 35946).

Albatross station 5205; off the eastern coast of Leyte; Caguayan Point bearing N. 2° E., 0.7 miles distant (lat. 11° 19′ 30″ N., long. 124° 58′ 05″ E.); 15 meters; April 13, 1908 [A. H. Clark, 1908, 1912] (2, U.S.N.M., 35014).

Bantayan Reef, Cebu; Dr. Laurence E. Griffin (2, M. C. Z., 381, 382).

Cebu [P. H. Carpenter, 1888; A. H. Clark, 1912].

Albatross station 5414; between Cebu and Bohol; Lauis Point Light bearing N. 67° W., 9.5 miles distant (lat. 10° 10′ 40″ N., long. 124° 02′ 45″ E.); no depth given; March 24, 1909 [A. H. Clark, 1911, 1912] (1, U.S.N.M., 35063).

Albatross station 5413; between Cebu and Bohol; Lauis Point Light bearing N. 68° W., 10 miles distant (lat. 10° 10′ 35″ N., long. 124° 03′ 15″ E.); 77 meters; March 24, 1909 [A. H. Clark, 1911, 1912] (1, U.S.N.M., 34990).

Ubay, Bohol, Philippines; Prof. Carl Semper [P. H. Carpenter, 1879, 1881, 1888; A. H. Clark, 1912].

Bohol; Prof. C. Semper [P. H. Carpenter, 1879, 1881, 1888; von Graff, 1884; A. H. Clark, 1912 (as Bohol)].

Albatross station 5248; Gulf of Davao, southeastern Mindanao; Lanang Point bearing S. 33° W., 0.4 miles distant (lat. 7° 07′ 25″ N., long. 125° 40′ 24″ E.); 33 meters; coral; May 18, 1908 [A. H. Clark, 1909, 1912] (1, U.S.N.M., 34980). Pl. 80, fig. 217.

Albatross station 5254; Gulf of Davao; Linao Point bearing N. 44° E., 0.7 mile distant (lat. 7° 05′ 42″ N., long. 125° 39′ 42″ E.); 38 meters; sand and coral; May 18, 1908 [A. H. Clark, 1909, 1912] (1, U.S.N.M., 35007).

Albatross station 5253; Gulf of Davao; Linao Point bearing N. 22° E., 1.5 miles distant (lat. 7° 04′ 48″ N., long. 125° 39′ 38″ E.); 51 meters; coral; May 18, 1908 [A. H. Clark, 1909, 1912] (2, U.S.N.M., 34969, 36041).

Siboga station 131; anchorage off Beo, Karakelang Islands, Talaoer group (southeast of Mindanao); reef, and also at 13 meters on mud and sand; July 24–25, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 133; anchorage off Lirung, Salibabu Island, Talaoer group; 36 meters; mud and hard sand; July 25–27, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Challenger; Zamboanga, southwestern Mindanao; 18 meters [von Graff, 1887; P. H. Carpenter, 1888; A. H. Clark, 1912, 1913] (8, U.S.N.M., 17525; B. M.). Pl. 79, figs. 213, 214.

Dr. Th. Mortensen's Pacific expedition, 1914–1916; Santa Cruz Island, Zamboanga; coral reef; February 25–28, 1914 (1).

Dr. Th. Mortensen's Pacific expedition, 1914–1916; off Jolo (Sulu); coral reef; March 20, 1914 (2); about 36–55 meters; sand and coral; March 19, 1914 (1).

Albatross station 5142; in the vicinity of Jolo (Sulu); Jolo Light bearing S. 50° W., 3.9 miles distant (lat. 6° 06′ 10″ N., long. 121° 02′ 40″ E.); 38 meters; coral sand and shells; February 15, 1908 [A. H. Clark, 1908, 1912] (1, U.S.N.M., 35011).

Albatross station 5137; in the vicinity of Jolo; Jolo Light bearing S. 61° E., 1.3 miles distant (lat. 6° 04′ 25″ N., long. 120° 58′ 30″ E.); 36 meters; sand and shells; February 14, 1908 (1, U.S.N.M., 34978).

Albatross; Pangasinan Island (near Jolo), south point; reef; February 13, 1908 [A. H. Clark, 1908, 1912] (1, U.S.N.M., 35054).

Siboga station 99; anchorage off North Ubian; June 28, 1899, to the west and June 30 to the east of the island; 16–23 meters [A. H. Clark, 1918] (21, U.S.N.M., E. 459; Amsterdam Mus.); surface [A. H. Clark, 1918] (1, Amsterdam Mus.).

Jolo (Sulu) archipelago [P. H. Carpenter, 1888 (as Sooloo); A. H. Clark, 1912] (2, H. M.).

Albatross; Tataan Island, Jolo Archipelago; February 19, 1908 [A. H. Clark, 1908, 1912] (1, U.S.N.M., 35004).

Albatross station 5147; Jolo Archipelago in the vicinity of Siasi; Sulade Island (E.) bearing N. 3° E., 8.4 miles distant (lat. 5° 41′ 40″ N., long. 120° 47′ 10″ E.); 38 meters; coral sand and shells; February 16, 1908 [A. H. Clark, 1908, 1912] (6, U.S.N.M., 34994, 35010).

Albatross station 5159; Tawi Tawi group, Jolo Archipelago; Tinakta Island (N.) bearing N. 82° W., 1.4 miles distant (lat. 5° 11′ 50″ N., long. 119° 54′ 00″ E.); 18 meters; coral sand; February 21, 1908 [A. H. Clark, 1908, 1912] (11, U.S.N.M., 34992, 35086, 35094).

Albatross station 5163; Tawi Tawi group; Observation Island bearing N. 79° W., 6.7 miles distant (lat. 4° 59′ 10″ N., long. 119° 51′ 00″ E.); 51 meters; coral sand; February 24, 1908 [A. H. Clark, 1908, 1912] (3, U.S.N.M., 34970, 35021).

Siboga station 96; Jolo Archipelago; south side of the pearl banks (between the Jolo Archipelago and Borneo); 15 meters; lithothamnion bottom [A. H. Clark, 1918]. (7, Amsterdam Mus.); plankton [A. H. Clark, 1918] (1, Amsterdam Mus.).

Albatross; Philippine Islands; no further data [A. H. Clark, 1908, 1912] (8, U.S.N.M., 34993).

Philippines; J. B. Steere (3, U.S.N.M., 36170).

Philippines [W. B. Carpenter, 1876; Greeff, 1876; P. H. Carpenter, 1876, 1877, 1880, 1881, 1887, 1888; Perrier, 1886; Hamann, 1889; A. H. Clark, 1912]. This refers to the specimens from Cabulaun, Ubay, and Bohol collected by Prof. Carl Semper.

North Borneo [Grube, 1875; P. H. Carpenter, 1888; A. H. Clark, 1912].

Siboga station 79*b;* Pulu Kabala-dua, Borneo Bank; shore; June 12–13, 1899 [A. H. Clark, 1918] (28, Amsterdam Mus.).

Siboga station 78; Lumu Lumu shoal, Borneo Bank; 34 meters; coral and coral sand; June 10–11, 1899 [A. H. Clark, 1918] (15, U.S.N.M., E. 402; Amsterdam Mus.).

Siboga station 81; Pulu Sebangkatan, Borneo Bank; reef; June 14, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Pacific Ocean (probably Jolo); United States Exploring Expedition (fragments, U.S.N.M., 2708).

No locality [J. Müller, 1841; Dujardin and Hupé, 1862; P. H. Carpenter, 1879, 1888]. Same; *Gazelle* [A. H. Clark, 1909, 1912; Hartmeyer, 1916] (2, Berl. M., 5332, 5418). Same [A. H. Clark, 1913] (1, B. M.). Same; from the Godeffroy Museum (1, B. M.). Same; a specimen in the Vienna Museum [P. H. Carpenter, 1888].

Geographical range.—From Madagascar, Mauritius, the Seychelles, and Baluchistan to Australia, south to Fremantle on the west and Moreton Bay on the east, New Caledonia, Fiji, Tonga, the Gilbert, Caroline, Pelew, and Bonin Islands, southern Japan, and Amoy, China.

Bathymetrical range.—From the low-tide mark down to 110 meters. Most of the records are from very shallow water.

Young individuals have twice been taken swimming at or near the surface (*Siboga* station 96 and 99).

Thermal range.—One record, 25.56° C.

Salinity.—One record, 1.023.

Occurrence.—Dr. Hubert Lyman Clark said that this is one of the loveliest crinoids found at Mer, but it is not at all common. The specimens taken were found on the under side of rock fragments.

Mr. Edgar Thurston wrote that on the coast of Madras he found individuals of this species clinging to gorgonians.

Two young 10-armed individuals of this species have been taken swimming at or near the surface, one at *Siboga* station 96, the other at *Siboga* station 99. The only other crinoid which has been captured at the surface is a young specimen of *Dorometra nana*.[11]

History.—This species was first described as *Alecto parvicirra* by Prof. Johannes Müller in 1841 from a specimen without locality in the Paris Museum. Müller did not himself study the specimen, but based his description on notes taken for him by Dr. F. H. Troschel. Later Müller visited the Paris Museum, and in his monograph published in 1849 he gave notes on another specimen from Vavao in the Tonga Islands which he found there. As his description of *Comatula* (*Alecto*) *parvicirra*, published in 1849, does not differ from the original description published in 1841, it is quite probable that he did not see the specimen which had been examined by Troschel.

Dujardin and Hupé in 1862 republished Müller's original description, calling the species *Comatula parvicirra*. Dujardin, who wrote the portion of this work dealing with the comatulids, had not at that time seen Müller's monograph, and therefore makes no mention of the specimen from Vavao. Apparently he was unable to identify the type specimen of *parvicirra* in the collection, for he said that it is "given by Müller as in the Paris Museum." Elsewhere he said that among the 24 species of comatulids in the Paris Museum there are 3 described by Müller, "assuming that *Comatula brevicirra* is identical with his *parvicirra*."

Prof. Christian F. Lütken in 1874 inserted the new name *Actinometra intricata*, followed by the localities Tonga and Fiji, in a list of comatulids printed in the catalogue of the Godeffroy Museum at Hamburg. This was repeated in 1877, when Port Denison was added to the localities. The specimen from Port Denison, and most of the others, are *Comanthus timorensis*, by 1 or 2 seem to have been *C. parvicirra*.

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[11] See vol. 1, pt. 2, pp. 596, bottom, and 606, second paragraph.

In 1875 Prof. Adolph Eduard Grube described a species which he called *Comatula mertensi* from North Borneo, based apparently on 2 specimens.

In 1876 Dr. W. B. Carpenter published notes on the nervous system of a comatulid which he called *Actinometra armata*, using a manuscript name which had been given to it by Prof. Carl Semper who had collected it during his residence in the Philippines, and in the same year Dr. P. H. Carpenter published other anatomical notes upon the same form. There are many subsequent references to the anatomy of this type, all of which, excepting the work of Hamann, who studied material sent him by P. H. Carpenter, are based upon the original investigations of the two Carpenters.

In 1879 Dr. P. H. Carpenter described in great detail a new species which he called *Actinometra polymorpha*. He remarked that the manuscript name *Actinometra armata* had been given to this type by Professor Semper on account of the small spines with which the segments of the arms and pinnules are fringed, more especially upon their dorsal and aboral margins. As, however, this character is a very general one among the comatulids, and as it is by no means so well developed in this type as it is in many others, Carpenter thought it advisable not to adopt Professor Semper's specific name *armata*, more especially as it had already been employed by Pourtalès to designate a new American species (*Analcidometra armata*).

Carpenter believed *polymorpha* to be very closely allied to, if not actually identical with, the type described by Müller as *Alecto parvicirra*. His diagnosis of *polymorpha* includes both *parvicirra* and *timorensis*. The locality is given as Bohol.

Carpenter's material consisted of 12 specimens, 8 of which he regarded as typical. The other 4 he diagnosed individually as varieties. Of these, variety 1, from Ubay, and variety 2, from Cabulaun, are referable to *parvicirra*, while variety 3, from Bohol, and variety 4, from Ubay, are referable to *timorensis*.

Of *parvicirra* he said that the type specimen does not exist in the Paris Museum under that name, nor even under the name of *Comatula brevicirra* Troschel (he should have said Valenciennes) which seems to have been used as an equivalent for it. He believed that 3 small specimens in alcohol from the voyage of Péron and Lesueur in 1803 which he found, together with 2 specimens of *Comatula pectinata*, under the name of *Comatula simplex*, are really those which were described by Müller as *parvicirra*.

In 1910 I examined these 3 small alcoholic specimens at the Paris Museum and found them to be examples of *Comanthus parvicirra*. One of them is now in the collection of the United States National Museum.

Speaking of Lamarck's *Comatula rotalaria*, Carpenter said that, according to Müller, there are only 2 radials in this species, which are united by syzygy, while they bear the IIBr axillaries directly, and these are also syzygial segments. He remarked that although, like Müller, he had examined Lamarck's original specimen of this species, he can not confirm Müller's statement. He noted that it is true that only 2 radials (that is, the 2 elements of the IBr series) are visible externally, but this is often the case in comatulids with a broad centrodorsal, and he was quite unable to satisfy himself that they are united by syzygy as described by Müller, and as in the case of the second and third radials of *Comatula solaris*, while he was equally unable to determine a syzygial union between the 2 segments of which the IIBr series are composed. He said that Lamarck's original specimen of *Comatula rotalaria* in the Paris Museum is wrongly labeled *Comatula brevicirra.*

A specimen from Cape Baudin collected by Péron and Lesueur is evidently the one which Carpenter found labeled *Comatula brevicirra* and took to be the type of Lamarck's *Comatula rotalaria.* It is also undoubtedly the one on which Dujardin (1862) based the suggestion that *brevicirra* and *parvicirra* are identical. This specimen I examined in 1910 and found to be an example of *Comanthus parvicirra.* It can not, however, be the type of that species.

Under the name of *Comatula rotalaria* I found the 2 specimens which were described by Lamarck as that species, and were later redescribed by Müller. They were properly labeled, and I do not understand how they were overlooked by Carpenter.

I also found and studied the specimen of *parvicirra* from the voyage of the *Astrolabe* collected by Hombron and Jacquinot at Vavao in 1841 and described by Müller in 1849.

In the same memoir Carpenter said that in 3 species of *Actinometra* from the *Challenger* collection the anterior arms are longest, although all the arms, anterior and posterior alike, are grooved and bear tentacles. He does not again refer to this statement, and he never indicated the species to which he referred. One of these species, however, he subsequently (1888) described under the name of *Actinometra elongata.*

In 1881 Carpenter published a further discussion of *Actinometra parvicirra* under which he placed as synonyms *Alecto timorensis* Müller, *Actinometra armata* P. H. Carpenter, and *Actinometra polymorpha* P. H. Carpenter.

He mentioned having found the specimen from Vavao in the Paris Museum under the name of *Comatula brevicirra.*

He said that 3 small specimens from the voyage of Péron and Lesueur may possibly be the originals of *Alecto parvicirra,* and remarked that the chief difficulty in the way of this identification is the fact that in all of them there are less than 20 arms, while Müller gave 27 for *parvicirra.*

He added that whether they are the types or not they are specifically identical with the one from Vavao which Müller had placed under *parvicirra.*

He wrote that the closer examination of the Paris specimens which he made during his second visit to the Paris Museum (in 1880), aided by the knowledge gained during 4 years of pretty continuous study of the comatulids, had led him to identify *parvicirra* with the series of specimens from the Philippine Islands which he had described under the name of *Actinometra polymorpha.*

Two specimens from Solor, one from Ceram, and another from an unknown locality in the East Indies which he found in the Leyden Museum were recorded, together with one from Kupang, Timor, in the Berlin Museum.

In the *Challenger* report on the stalked crinoids (1884) Carpenter published many anatomical observations on this species based on dissections of some of Semper's specimens from the Philippines. He also mentioned it as the type of a special species group within the genus *Actinometra* characterized by having the IIBr series 4 (3+4).

Prof. F. Jeffrey Bell in 1884 recorded, as *Actinometra parvicirra,* a small specimen collected by the *Alert* at Warrior Reef and determined for him by Dr. P. H. Carpenter, and another from Port Molle. A second example from Port Molle he recorded under the name of *Actinometra cumingii.*

In an article on the cirri of comatulids published in 1886 Carpenter mentioned that in this species there are no cirri of the "small mature" type.

Professor Bell in 1887 recorded *Actinometra parvicirra* from Ceylon, the record being based upon specimens of both *parvicirra* and *timorensis.* An additional specimen of *parvicirra* he recorded under the name of *Actinometra cumingi.* In the same year Prof. Ludwig von Graff described the myzostomes which Carpenter had found on some specimens collected by the *Challenger* at Zamboanga.

In 1888 Bell recorded specimens from Tuticorin, Madras, which had been collected by Mr. Edgar Thurston. Among these were representatives of *Capillaster multiradiata*, *Comanthus parvicirra*, and *C. timorensis.* In a list of the echinoderms of the Sea of Bengal published in the same paper Bell included *Actinometra cumingii*, the record being based upon a specimen of *parvicirra.*

In his report on the comatulids collected by the *Challenger* published in 1888 Carpenter discussed this species at some length. He noted the occasional occurrence of a stellate centrodorsal with rudimentary cirri, and mentioned the variation in the IIBr series, citing specimens, including one in the Vienna Museum, in which 5 of the IIBr series are 2 and 5 are 4 (3+4). He says that, in view of the variability in the IIBr series, it is necessary to use for systematic purposes the majority occurrence. He called attention to the very wide distribution of this species as understood by him, and spoke of the existence of different varieties in the same place as illustrated by the 5 varieties in the series of specimens which he had described under the name of *Actinometra polymorpha*, 2 of which are found at Ubay and 2 at Bohol. He noticed the occurrence of spherodes in the posterior arms, and gave the number of arms, as he had done in 1879, as 13–39.

Carpenter made *parvicirra* the type of a special group of species within the genus *Actinometra*, the *Parvicirra* group, which is characterized by having the IIBr series 4 (3+4), a pinnule on the second brachial but none on the first, and the first syzygy between brachials 3+4.

In his key to the species of this group *parvicirra* appears three times—(1) among species with IIBr series only, (2) among species with IIIBr series, and (3) among species with IVBr series.

In the synonymy of *parvicirra* he included *timorensis* Müller, *wahlbergii* Müller, *mertensi* Grube, *armata* P. H. Carpenter, *polymorpha* P. H. Carpenter, *meyeri* P. H. Carpenter, *annulata* Bell, and *mutabilis* Lütken, MS., in part. He thus included under *parvicirra* the forms here given as *Comanthus wahlbergii*, *Comanthus timorensis*, and *Comanthus parvicirra.*

He gave a description and detailed discussion of *Actinometra parvicirra* as understood by him, and recorded 18 specimens from 7 *Challenger* stations. He also gave a list of all the localities from which he had seen specimens.

The allocation in the present work of the specimens recorded by Carpenter is as follows: *Comaster distincta*, Zamboanga ("Samboangan") (part); *Comanthus wahlbergii*, Simon's Bay, Cape of Good Hope, Durban ("Port Natal"); *Comanthus samoana*, Peru; *Comanthus parvicirra*, *Challenger* stations 174, 186 (part), Banda (part), Ternate, Admiralty Islands, Zamboanga, Ceylon (part), Nicobar Islands, Australian seas, Timor (part), Solor, North Borneo, Jolo ("Sooloo"), China Sea, Tokyo ("Yedo"), Cebu ("Zebu") (part), Bohol (part), Ubay (part), Cabulaun ("Cabulan"), Ceram, Warrior Reef, Torres Straits (part), Port Molle, Gilbert ("Kingsmill") Islands, Moreton Bay, Queensland (not Fiji), Vavao; *Comanthus timorensis, Challenger* station 186 (part), Banda (part), Ceylon (part), Timor (part), Cebu (part), Bohol (part), Ubay (part), Batjan, Torres Strait (part).

He said that although on two occasions (1876 and 1880) he had searched carefully through the large comatulid collection in the Paris Museum he had been unable to identify the original type of Müller's *parvicirra*. The number of arms mentioned by Müller, 27, is larger than in some individuals from the voyage of Péron and Lesueur which certainly belong to this species, though he did not think that they can be the types of it as he formerly suggested. But he could find no reference to them in any of Müller's writings, though he must certainly have seen them when in Paris, while they must also have been known to Lamarck, who based other species on comatulids obtained by Péron and Lesueur.

He remarked that although Müller's type specimen seems to have disappeared, the one from Vavao which he described in 1849 is in excellent condition.

Müller's *Alecto wahlbergii* he said he was for a long time inclined to regard as specifically distinct from *parvicirra*, but finally he had been obliged to abandon this view and had been forced to consider it as another variety of *parvicirra*.

He noted that he had examined the types of Grube's *Comatula mertensi* and found them to be identical with *parvicirra*. His reasons for reducing *armata* and *polymorpha* to synonyms of *parvicirra* are given. His *Actinometra meyeri* and Bell's *Actinometra annulata* were placed in the synonymy of *parvicirra*, and the reasons for this disposition were given.

He mentioned having found some specimens which had been distributed by the Godeffroy Museum bearing the name *Actinometra mutabilis* Lütken, MS., from Moreton Bay and the Nicobar Islands.

Carpenter described a new species, *Actinometra quadrata*, in the *Parvicirra* group which he distinguished from *parvicirra* by its relatively much longer brachials. The type was a *Challenger* specimen from the Tongatabu reefs, but he said that some specimens from the Nicobar Islands in the museums at Copenhagen and at Vienna should perhaps be referred to it on account of the length of their brachials. Further on (under *parvicirra*) he remarked that 1 or 2 specimens among those collected by the *Challenger* at Zamboanga appear to approach *quadrata*, and it may be that the latter name will have to be abandoned.

Within the genus *Actinometra* Carpenter established another species group which he called the *Valida* group, which was characterized by having the IIBr series 2 and the first syzygy between brachials 3+4. He said that 2 somewhat different types of structure are included in this group—(1) forms with IIIBr series like the IIBr series, and (2) forms with the IIIBr series 4 (3+4). In addition to these there are also species, like *elongata* and *simplex*, which normally have no IIIBr series at all.

The species which he assigned to this group, the localities whence they came, and the number of specimens he examined are as follows: *Actinometra elongata*

(Banda, 1 specimen); *Actinometra simplex* (Admiralty Islands, 1 specimen); *Actinometra rotalaria* (Zamboanga, 18 meters, 2 specimens; Australia, 1 specimen); *Actinometra valida* (*Challenger* station 186, 1 specimen).

As I have explained above, the specimen from Australia in the Paris Museum which Carpenter took to be the type of Lamarck's *Comatula rotalaria* is in reality quite a different thing. Carpenter did not actually see the specimens which were described by Lamarck and redescribed by Müller.

The 2 specimens from Zamboanga determined as *Actinometra rotalaria* and the single specimens of *Actinometra simplex* and *Actinometra elongata* are simply examples of *parvicirra* with more IIBr 2 series than usual. The single specimen of *Actinometra valida* is an example of *timorensis* with more IIBr 2 series than usual.

Speaking of *Actinometra elongata* and *Actinometra simplex*, Carpenter said that with one exception, which is in the national collection (British Museum), these are the only comasterids which have such a simple arm structure—that is, the IIBr series 2 and no IIIBr series. He said nothing more about this specimen, which is one of those collected in Torres Strait by Prof. J. Beete Jukes.

In 1891 Dr. Clemens Hartlaub recorded and gave notes upon a number of specimens identified as *Actinometra parvicirra* from various localities.

He divided *parvicirra* into 2 types which he called A and B. Type A is the equivalent of *Comanthus samoana*, while Type B includes *Comanthus parvicirra* and *C. timorensis*.

The allocation in the present work of the specimens recorded is as follows: *Comanthus samoana*, Amboina (part), Peru, Samoa; *Comanthus parvicirra*, Amboina (part), Ponapé ("Panope"), Moreton Bay; *Comanthus timorensis*, Amboina (part), Mortlock Island, Lombock Strait, Fiji, Tonga (2), Atjeh.

Hartlaub found the following manuscript names of Lütken associated with some of the specimens he examined: *Actinometra guttata*, with a specimen from Fiji (=*timorensis*); *Actinometra intricata*, with 2 specimens from Tonga (=*timorensis*); *Actinometra mutabilis*, with specimens from Moreton Bay (=*parvicirra*); *Actinometra trachygaster*, with specimens from Peru (=*samoana*).

He accepted and referred to Carpenter's synonymy for this species; but he mentioned a specimen from Tonga with 39 arms and all of the IIBr series 2 which, according to Carpenter's scheme, would fall in *Actinometra valida*.

In 1894 Professor Bell recorded *Actinometra parvicirra* from northwestern Australia, but the specimens upon which this record was based represented *Comatula pectinata* and *Comantheria briareus*. In the same paper he recorded *parvicirra* from the Macclesfield Bank, these specimens representing *Comaster brevicirra* and *Comanthus parvicirra*.

Mr. Edgar Thurston in 1894 recorded *parvicirra* from the Gulf of Manaar and Tuticorin, the identification of his specimens having been made by Bell, who in 1888 published an advance notice of them.

In 1895 Prof. René Koehler recorded *parvicirra* from the Bay of Amboina, and in 1898 Prof. Ludwig Döderlein again recorded it from Amboina. In 1899 Bell recorded this species from Sandal Bay, Lifu, where it had been collected by Prof. Arthur Willey, and in 1900 Prof. Georg Pfeffer recorded it from Ternate.

Mr. Herbert C. Chadwick in 1904 recorded *Actinometra parvicirra* from a number of localities about Ceylon, his specimens representing *Comanthus parvicirra* and *C. timorensis*, and *Comissia chadwicki*.

Shortly after taking up the study of the crinoids in 1907 I discovered that *Actinometra* is a pure synonym of *Comatula*. In transferring Carpenter's species from *Actinometra* to *Comatula* I found that his *Actinometra* (now *Comatula*) *simplex* described in the *Challenger* report was preoccupied by the *Comatula simplex* mentioned by him in 1881. As he gave a few of the characters of the latter, the name can not be considered as a *nomen nudum*. The *Actinometra simplex* described in the *Challenger* report I therefore renamed *Comatula orientalis*. Later in the same year I published a revision of the genus *Actinometra* as understood by Carpenter, dividing it into 2 genera, *Comatula* and *Comaster*. In this paper I did not attempt a revision of the species, but simply listed under *Comaster* the various forms admitted in the *Challenger* report and here referred to *parvicirra*.

In July, 1908, in a paper on the crinoids of Japan based on the collection of Mr. Alan Owston, I recorded *Comaster parvicirra* from 2 localities in Sagami Bay. These specimens subsequently proved to be examples of *Comaster serrata*. In a paper published in August, 1908, I noted that in 1849 Müller had placed his *Alecto elongata*, described in 1841, in the genus *Comatula*, as *Comatula elongata*. If *Actinometra* is to be considered as a synonym of *Comatula*, then the *Actinometra elongata* described by Carpenter in the *Challenger* report also becomes *Comatula elongata*. For Carpenter's *Actinometra elongata* I therefore suggested the name *Comatula helianthus*.

The previous revision of the species included by Carpenter in the genus *Actinometra* having proven unsatisfactory, on October 30, 1908, I published another based on a detailed study of the brachial homologies. In this paper the described forms herein considered as synonymous with *parvicirra* were referred to the genus *Phanogenia*.

Shortly after this paper was written I received the first installment of the crinoids from the *Albatross* cruise in Philippine and adjacent waters. This series, from 7 different *Albatross* stations and also including specimens with no definite locality, made it clear that the forms described by Carpenter in the *Challenger* report under the names of *Actinometra parvicirra* and *Actinometra rotalaria* are specifically identical, and I therefore called the type *Comanthus rotalaria*.

In regard to the use of Lamarck's name *rotalaria* I said that some question might of course arise in regard to the correctness of Carpenter's conception of *rotalaria;* but he personally examined minutely the collection at Paris, and so careful was he in regard to specific discrimination that I believe we are safe in assuming the identity of the Paris specimens and those dredged by the *Challenger* at Zamboanga.

In 1909 I recorded *Comanthus rotalaria* from 4 additional *Albatross* stations in the Philippines, and in another paper recorded specimens which had been collected by the *Gazelle*, some at Timor and some at an unknown locality.

Dr. Th. Mortensen had been so kind as to send me for examination in 1908 the remarkably fine comatulid collection of the Zoological Museum in Copenhagen. A study of this collection, in connection with that made in the Philippines by the *Albatross*, showed that *parvicirra*, as understood by Carpenter, is divisible into a large many armed and a smaller few armed type. In my report on this collection, published in 1909, I distinguished these 2 types as *Comanthus* (*Comanthus*) *valida* and *Comanthus* (*Comanthus*) *rotalaria*. In a preliminary paper published in 1908 I had described as a new species *Comanthus intricata*, which was based on a specimen from Bowen bearing the name *Actinometra intricata* Lütken, MS. Shortly afterwards I discovered that my *intricata* was the same as Carpenter's *valida*. In 1909 I wrote that I was quite unable to find any valid characters by which *intricata* might be distinguished from the previously described *valida*, and said that I had been misled by the fact that Carpenter made *valida* the type of a special group distinct from the *Parvicirra* group. When I described *intricata* I had not yet discovered that the *Valida* group is composed of 4 supposed species, 3 of which are synonymous with *parvicirra* of the *Parvicirra* group, while the fourth is synonymous with my *intricata* and, as shown by some specimens lately come to hand [the *Albatross* specimens from the Philippines], also with Carpenter's *littoralis* of the *Parvicirra* group.

Under *Comanthus* (*Comanthus*) *rotalaria* I included as synonyms *parvicirra* J. Müller, *timorensis* J. Müller, *wahlbergii* J. Müller, *brevicirra* Dujardin and Hupé (*nomen nudum*), P. H. Carpenter, *simplex* Dujardin and Hupé (*nomen nudum*), P. H. Carpenter, *trachygaster* Lütken (*nomen nudum*), P. H. Carpenter, *intricata* (part) Lütken (*nomen nudum*), Hartlaub, *mertensi* Grube, *armata* (Semper, MS.) W. B. and P. H. Carpenter, *polymorpha* P. H. Carpenter, *meyeri* P. H. Carpenter, *mutabilis* (Lütken, MS.) von Graff (*nomen nudum*), P. H. Carpenter, *elongata* P. H. Carpenter, *simplex* P. H. Carpenter, *quadrata* P. H. Carpenter, *guttata* (Lütken, MS.) Hartlaub, *orientalis* A. H. Clark, and *helianthus* A. H. Clark.

The records which I gave are in the present work allocated as follows: *Comantheria imbricata*, off the Goto Islands; *Comaster tenella*, Singapore, April 16, 1907 (7); *Comanthus samoana*, ?Australia; *Comanthus timorensis*, Fiji, Singapore, November 27, 1907 (1); *Comanthus parvicirra*, Tonga Islands, Nicobar Islands, China Sea, near the Pescadores Islands, and Singapore, except for the 8 specimens listed above.

The identity of *parvicirra* and *rotalaria* as described by Carpenter and the artificial nature of the *Valida* group was further discussed.

In 1910 I examined the crinoids in the Paris Museum, and in a paper on the crinoids of the coasts of Africa published in March, 1911, I stated that the types of Lamarck's *Comatula rotalaria* did not represent Carpenter's *Actinometra rotalaria*, but instead were conspecific with Carpenter's *Actinometra jukesii* and with Bell's *Actinometra paucicirra*. The name *rotalaria* not being available for this species, I adopted the name *parvicirra*.

A study of the material in the European museums had shown that the South African specimens represented a form which was abundantly distinct from *parvicirra*, and this I recognized under the name of *Comanthus* (*Bennettia*) *wahlbergii*.

Comanthus (*Validia*) *parvicirra* was recorded from the Seychelles, and I remarked that in the Berlin Museum I had seen some immature comatulids from the Seychelles and some others from the Red Sea that may belong to this species. The former represent in reality *Comissia ignota* and the latter *Comissia hartmeyeri*. As *Comanthus*, sp., I recorded specimens from Madagascar and Mauritius which I remarked are very close to, if not, *C. parvicirra*.

In a paper on the crinoids of the Leyden Museum published in 1911 I recorded *Comanthus parvicirra* from the Indian Ocean, Ceram, Timor, and Solor. The specimen from the Indian Ocean is in reality *C. timorensis*, while those from Timor are the types of that form. Those from Ceram and Solor represent *C. parvicirra*. In an appendix to this paper Dr. R. Horst listed *Comanthus parvicirra* from Atjeh, this record referring to a specimen which I had failed to mention. This is the specimen which was recorded from Atjeh by Hartlaub in 1891 and represents *C. timorensis* as here understood.

In a paper on the crinoids of the Paris Museum published in 1911 I recorded and gave notes upon specimens of *C. parvicirra* from the Australian seas and Cape Baudin, from Vavao, Cape St. André, Madagascar, and from New Caledonia.

In a memoir on the crinoids of Australia (1911) I gave a revised synonymy of this species, adding Bell's *Actinometra cumingii* from Port Molle and *Actinometra variabilis* (in part) from northwest Australia [Bassett-Smith Bank, 9 fathoms]. Notes were given on 2 specimens from Port Molle and 1 from the New Hebrides in the Australian Museum, and a specimen from Fremantle in the British Museum was recorded. The confusion in regard to Lamarck's *Comatula rotalaria* was explained, Müller's *Alecto wahlbergii* was said to be very distinct from *parvicirra* and much more like *C. trichoptera*, and Carpenter's *Actinometra meyeri* and Bell's *Actinometra annulata*, of both of which I had seen the types in the previous year, were said to be in reality the same as Carpenter's *Actinometra valida*.

In a report on the crinoids collected by the Hamburg southwest Australia expedition in 1905 which was published in 1911 a summary of the occurrence of this species in Australia, with special reference to the west coast, was given.

In a short paper on the species of *Comissia* which appeared in 1911 the 10-armed specimen described and figured by Chadwick was identified as a species of that genus.

In a paper on the comatulids of the Berlin Museum published in 1912, 7 lots of specimens, each from a different locality, were recorded. The specimen from Batjan was included by error. It is the same as that recorded from Batjan (No. 3) under *Comanthus annulata* (=*timorensis*) just above.

The specimens in the Hamburg Museum were described in another paper published in 1912, wherein 8 lots were listed. The 4 specimens from Peru are described in detail. They properly represent *Comanthus samoana* and not *C. parvicirra*. I again remarked that the Peru in this case might be Peru or Francis Island in the Gilbert (Kingsmill) group and added that Professors Pfeffer and Michaelsen told me that the specimens collected by Vierau form part of a very old collection and that the localities as given are unreliable.

In my monograph of the crinoids of the Indian Ocean published in 1912 a complete synonymy of this species is given which, as in the case of the previous synonymies, includes *timorensis* and a few other references to the same type.

Specimens are recorded from 8 new localities. Three of the 10 from Galle and that from Port Blair are referable to *timorensis* rather than to *parvicirra*. A list of the known localities is given. The specimens from "Australia" and Samoa are in reality *Comanthus samoana*. Those from Mortlock Island, Batjan and Lombock

Strait are in reality *C. timorensis*. Those from the Red Sea are in reality *Comissia hartmeyeri*. The specimens on which a number of the other locality records are based, as explained above, include both *parvicirra* and *timorensis*. Panopé (Ponape) is inadvertently given as in New Guinea instead of as in the Gilbert Islands.

In an account of the comatulids in the collection of the British Museum published in 1913 I recorded and gave notes on 33 lots of specimens, most of which had previously been noticed by Bell or by Carpenter. One of the specimens from Banda (with about 40 arms) should have been referred to *timorensis* (*annulata*). In another paper published in the same year I gave the known records of this species from eastern Asia.

Dr. August Reichensperger in 1913 recorded 4 specimens, collected by Doctor Sarasin, from Ceylon; 1, collected by Professor Strubell, from Amboina; and 1, collected by Dr. H. Merton, from the Aru Islands. The last is in really *timorensis*.

In 1914 I recorded a specimen which had been dredged by the *Endeavour* between Fremantle and Geraldton, Western Australia, and in 1915 Dr. H. L. Clark recorded a specimen from Ceylon. In another paper published in 1915 Doctor Clark recorded this species from Mer in the Murray Islands, and gave notes on its occurrence and colors in life.

Dr. Robert Hartmeyer in 1916 published a correction of the catalogue numbers which I had given in 1912 for the specimens in the Berlin Museum from Amboina and from New Guinea, and for some without locality, and in addition listed some fragments without locality in the museum collection.

In 1918 I recorded and gave notes upon specimens of this species which had been collected by the *Siboga* at 23 stations, and added a synonymy in which Müller's *Alecto timorensis* was included. Two young individuals were mentioned as having been taken swimming at or near the surface.

In 1921 Dr. H. L. Clark wrote that this is the most perplexing comatulid found at Mer, for while typical specimens are easily recognized, the intergradations with *timorensis* (*annulata*) are very puzzling.

Doctor Clark remarked that as many specimens of *timorensis* have only from 21 to 29 arms and often have cirri, sometimes XVIII or XIX, it is only by a careful weighing of all the characters that the 2 species can be distinguished. He said that he was by no means sure that they really ought to be regarded as distinct, but on the other hand it seemed to him unwise to include them under a single name.

In 1922 in his report on the crinoids collected by Dr. Sixten Bock on his expedition to Japan Dr. Torsten Gislén recorded *parvicirra* from 2 stations in the Bonin Islands and also from Misaki, Japan.

He placed as synonyms under *parvicirra* the *Comaster multifida* and *Comaster typica* described by him from specimens in Mjöberg's collection in 1919.

The figure which he published of specimen 2 of *Comaster typica* (station 13) shows quite a typical example of *Comantheria rotula*. The other specimen of *typica* (station 5) appears probably to have been an example of *parvicirra*. Of the 3 specimens incuded under *Comaster multifida*, the 2 from station 5 appear to represent *parvicirra*, while the 1 from station 1 seems to be referable to *Capillaster multiradiata*.

Gislén divided *parvicirra* into 2 "subspecies" which he called *Comanthus* (*Vania*) *parvicirra* α *comasteripinna* and *Comanthus* (*Vania*) *parvicirra* β *comanthipinna*, and mentioned incidentally a third subspecies which he called *Comanthus* (*Vania*) *parvicirra* γ *vaniipinna*, to which he tentatively referred a specimen from Bock's station 63.

In 1923 Dr. H. L. Clark recorded 7 specimens of this species from Wooded Isle in the Abrolhos group, Western Australia, and in 1927 Doctor Gislén recorded 9 specimens collected by Dr. Th. Mortensen in Japan in 1914, placing 3 under *Comanthus parvicirra* α *comasteripinna* and 6 under *Comanthus parvicirra* γ *vaniipinna*.

DOUBTFUL AND INDETERMINABLE SPECIES

YOUNG COMASTERIDS FROM THE BONIN ISLANDS

Dr. Torsten Gislén has described the following young comasterids which were collected by Dr. S. Bock in the Bonin Islands:

COMATELLA, sp.

Locality.—Two miles west of Higashijima; 164 meters; sand and broken shells; August 7, 1914.

Notes.—The cirri are XI, 8–9, from 2 to 2.5 mm. long. The third segment is two and one-half times as long as broad. The terminal claw is curved, and is longer than the penultimate segment.

The basals project between the radials as small corners. The radials are narrow bands. The IBr_1 is three times as broad as long. The 10 arms are about 15 mm. long. The edges of the brachials are somewhat everted and spiny. The intersyzygial interval is 3 muscular articulations.

P_1 has comb of 5 or 6 teeth. P_2 and P_3 are absent.

The disk is smooth, dark brown in color. The mouth is central. The anal tube is small and is not papillated.

COMATELLA, sp. juv., OR THE YOUNG OF A LARGE COMISSIA, sp.

Locality.—East of Chichijima; 146 meters; July 31, 1914.

Notes.—In one specimen the cirri are XIX, 14–16, from 6 to 8 mm. long. The fourth segment is the longest, two and one-half times as long as broad. Dorsal spines are present from the fourth segment onward.

The radials are narrow and bandlike. The IBr_1 are four times as broad as long and are free laterally. The IBr_2 (axillaries) are twice as broad as long, and they form with the IBr_1 a low synarthrial tubercle.

The 10 arms are 45 mm. long. The second brachials are twice as long exteriorly as interiorly. The distal brachials are half again as long as broad, feebly spiny, with the ends not everted.

The intersyzygial interval is 3 muscular articulations.

P_1 is 5.5 mm. long and is composed of from 25 to 30 segments, of which 10 bear teeth; it is strongly rolled up distally. P_2 bears a comb. P_3 is usually and P_4 is always absent.

The mouth is subcentral, and the anal cone is small and marginal. The disk is 4 mm. in diameter.

Gislén says that this is probably the young of *Comissia magnifica.*

A second specimen has the cirri XIII, 12–14, from 4 to 5 mm. long. The third and fourth segments are twice as long as broad.

The 10 arms are 25 mm. long.

P_1 and P_2 bear combs, that on P_1 consisting of 9 teeth. P_4 is always and P_3 is usually absent.

The disk is 2.5 mm. in diameter. The mouth is central.

Gislén remarks that, like the preceding, this is probably the young of *Comissia magnifica.*

In a third specimen the cirri are XII, 10–11, 2.5 mm. long. The 10 arms are 15 mm. long. P_1 is present and bears a comb. The following pinnules are absent as far as the eleventh or thirteenth brachials The disk is 2.5 mm. in diameter and the mouth is central.

Gislén suggests that this may be the young of *Comissia magnifica.*

Locality.—East of the Channel; 146 meters; August 1, 1914.

Notes.—In one specimen the cirri are XVII, 12–15, from 6 to 7 mm. long. The third and fourth segments are from half again to twice as long as broad.

The IBr_1 are three times as broad as long, and are free laterally. The IBr_2 (axillaries) are half again as broad as long and pentagonal. The 10 arms are 30 mm. long. The first brachials are four times as broad as long, and the second are three times as broad as long. The arm bases are smooth. The intersyzygial interval is 3 muscular articulations.

P_1 bears a comb consisting of about 15 teeth; P_2 bears a comb; P_3 bears a comb of 8–11 teeth; P_4 is lacking. The distal pinnules are 3.5 mm. long and are composed of 12–14 segments of which the last 3 bear strong dorsal hooks.

The disk is smooth, dark brown, 3.5 mm. in diameter. The mouth is subcentral. The anal tube is short. The disk is half detached, and a new one is forming beneath it.

Gislén suggests that this is perhaps a young example of *Comatella maculata* or of *C. stelligera.*

In another specimen the cirri are XI, 8–9, 2 mm. long. The third segment is the longest—three times as long as broad. The IBr_1 is four times as broad as long. The IBr_2 (axillary) is twice as broad as long, triangular with the very concave distal edges forming an acute distal angle. The 10 arms are 10 mm. long. The brachials are everted and spiny. P_1 is 2.5 mm. long and has a comb consisting of 7 teeth. P_2 is absent. P_3 is without a comb.

Gislén suggests that, like the preceding, this is perhaps a young example of *Comatella maculata* or of *C. stelligera.*

Locality.—Eastsoutheast of the Channel; 152 meters; August 16, 1914.

Notes.—The cirri are XV, 9–12, 3.5 mm. long. The radials are four times as broad as long. The IBr_1 are three times as broad as long. The IBr_2 (axillaries) are twice as broad as long. The 10 arms are 20 mm. long. The intersyzygial interval is 3 muscular articulations. The comb on P_1 consists of 9 well-separated teeth. P_2, P_3, and P_4 are lacking. The disk is 2 mm. in diameter, pentagonal, and dark brown. The mouth is central and the anal funnel is small.

YOUNG OF COMASTER SERRATA

Locality.—East of Chichijima; 146 meters; July 31, 1914.

Notes.—The cirri are XIV, 9, 2 mm. long. The radials are four times as broad as long. The IBr_1 are three times as broad as long. The 10 arms are 10 mm. long. The brachials are strongly serrate and everted. P_1 and P_2 (if present), with a short high comb; P_3 and P_4 absent. The mouth is central. In other respects this individual resembles the specimen of *Comaster serrata* taken at the same station (45).

YOUNG PROBABLY OF COMANTHERIA DELICATA

Locality.—East of the channel; 146 meters; August 1, 1914.

Notes.—The cirri are XIII, 9, from 2.5 to 3 mm. long. The third and fourth segments are two and one-half times as long as broad.

The 10 arms are from 15 to 20 mm. long. The arm bases are rather strongly serrate. There is a close synarthry between the first 2 brachials. The intersyzygial interval is 3 muscular articulations. P_1 and P_2 (when present) bear a short high comb of 4–5 teeth. P_3 is absent. None of the distal pinnules bear combs.

The disk is 1.2 mm. in diameter. The mouth is central. The anal tube is short and shaped like a wart. The anal interradius has calcareous plates in the perisome, but no papillae.

Locality.—Northwest of Ototojima; 128 meters; July 31, 1924.

Notes.—The cirri are XIII, 9–10, from 3 to 4 mm. long. The third-fifth segments are the longest—twice as long as broad.

The radials are seven times as broad as long. The IBr_1 are three times as broad as long, free laterally, closely articulated with the axillary, which is pentagonal and half again as broad as long. The first brachials are basally united interiorly. The 10 arms are 22 mm. long. The brachials are rather long, with their distal ends somewhat everted and spiny. Proximally the arms are well separated. The intersyzygial interval is 3 muscular articulations.

P_1 is 2.5 mm. long with 21 segments, of which 5 bear large teeth in height equal to three times the width of the segment bearing them. P_2, P_3, and sometimes P_4 are absent. The pinnule segments are very spiny. The distal pinnules are 3 mm. long and are composed of 14 segments, of which the third and following are four times as long as broad. There are no combs on the distal pinnules.

The disk is 3 mm. in diameter and reaches to the second brachial. The anal tube is subcentral, swollen, and papillated.

YOUNG OF A SPECIES OF COMANTHERIA

Locality.—East of Chichijima; 146 meters; July 31, 1914.

Notes.—The cirri are XIV, 11–17, from 3 to 6.5 mm. long. The fourth segment is the longest, from one-third to one-half again as long as broad. From the seventh segment onward subterminal dorsal prominences occur. The opposing spine in height is equal to one-third the width of the penultimate segment, and is stouter and more sharply pointed than the preceding processes. The cirri of the dorsal row are considerably more delicate.

The radials are seven times as broad as long. The IBr_1 are three times as broad as long and are laterally free; they form a weak synarthrial tubercle with the axillary, which is twice as broad as long with somewhat concave distal sides.

The 10 arms, which are all broken, are 15+ mm. in length. The first brachials are interiorly united for two-thirds of their length. The arm bases are tolerably smooth; after the seventh brachial the distal edges are slightly everted and spiny. The width of the arms proximally is from 0.6 to 0.8 mm.

Syzygies occur between brachials 3+4, 11+12, and 16+17, and distally at intervals of 4 muscular articulations.

P_1 is 5.5 mm. long and is composed of 27 segments. The comb is made up of 9–11 rather low triangular teeth which in height equal three-quarters the width of the segments. P_2 is 3 mm. long and bears a comb of 6 teeth. P_3 bears a rudimentary comb, and P_4 is without a comb; the last is 1.5 mm. long and is composed of 11 segments.

The disk is 4 mm. in diameter, and is smooth without papillae. The mouth is somewhat displaced marginally. The anal tube is subcentral, chimney shaped, 1.5 mm. high.

Another specimen has the cirri XIX, 9–12, from 2 to 4.5 mm. long. The basals are visible in the interradial angles. The radials are five times as broad as long. The distal edges of the axillaries are everted and spiny. The 10 arms are 25 mm. long. The distal brachials are twice as long as broad and are strongly constricted centrally and spiny. Syzygies occur between brachials 3+4 and 11+12 and distally at intervals of usually 3 muscular articulations.

P_1 is 3 mm. long with about 20 segments and bears a comb of about 5 coarse teeth. P_2 is absent. P_3 is 1.5 mm. long with 7 segments and is without a comb.

The disk is 2.5 mm. in diameter. The mouth is somewhat displaced. The anal funnel is 1 mm. high.

Gislén remarks that it is doubtful if this last individual belongs to the genus *Comantheria*.

YOUNG INDIVIDUAL OF A SPECIES OF COMANTHUS (COMANTHUS)

Locality.—Chio-ta-jima; shore at low tide; August 3, 1914.

Notes.—The cirri are XII, 9, from 2 to 3 mm. long, slender, in a single row. The fourth segment is the longest—twice as long as broad. The centrodorsal is low and flattened.

The radials are narrow bands, five times as broad as long. The IBr_1 are twice as broad as long and are laterally free. The IBr_2 (axillaries) are half again as broad as long, pentagonal.

The 10 arms are 12 mm. long. The first brachials are well separated interiorly. The synarthry between the first and second brachials is usually rather similar to the syzygy between brachials 3+4. The first and second brachials are three times as broad as long, somewhat longer exteriorly than interiorly. The brachials are serrate and only slightly overlapping.

The intersyzygial interval is 3 muscular articulations.

P_1 has a comb consisting of about 6 teeth. P_2 and P_3 are rudimentary or lacking. The following pinnules are without a comb. The distal pinnules are 2.5 mm. long.

The disk is 2.5 mm. in diameter and reaches to the first brachial. The mouth is displaced marginally. The anal cone is smooth, 1.2 mm. high, sharply set off with a whorl of papillae around the opening.

The color is yellow brown.

UNDETERMINABLE YOUNG COMASTERIDS

Locality.—East of the Channel; 146 meters; August 1, 1914.

Notes.—The cirri are XVIII, 12–17 (usually 15–17), from 4 to 8 mm. long. The opposing spine is a little longer than the dorsal processes on the preceding segments.

The axillaries are twice as broad as long. There are 2 regenerating IIBr series, of 2 elements each.

The 12 arms are 30 mm. long. The intersyzygial interval is 3 or 4 muscular articulations.

P_1 is 5.5 mm. long with about 26 segments and a comb of 6–7 teeth. P_2 and P_3 are often very small, only 1 or 2 mm. long. P_4 bears a comb. The distal pinnules are 4.5 mm. long with 12–13 segments.

The disk is 3.5 mm. in diameter. The mouth is marginal. The anal tube is subcentral, slender and papillated, sharply set off from the disk, 2 mm. high.

Gislén says that this specimen differs from the *Comatellas* described previously in the formation of the disk.

Locality.—East of Chichijima; 128 meters; broken shells and sand; August 7, 1914.

Notes.—The centrodorsal is 0.8 mm. in diameter. The cirri are XIII, 9–10, from 2.5 to 3 mm. long. The third segment is two and one-quarter times as long as broad.

The radials, which are partly concealed by the angular centrodorsal, are four times as broad as long. The IBr_1 are twice as broad as long. The IBr_2 (axillaries) are half again as broad as long, with the distal margins somewhat concave.

The 10 arms are 15 mm. long. The first brachials are twice as broad as long, no longer exteriorly than interiorly, interiorly united. The second brachials are twice as broad as long, a little longer exteriorly than interiorly. The brachials are long, serrate, and everted.

Syzygies occur between brachials 3+4 and distally at intervals of 3 muscular articulations.

The comb on P_1 consists of 8 heart-shaped teeth. P_2 and P_3 are absent. The distal pinnules are 3 mm. long. The disk is 2.2 mm. in diameter. There are interradial calcareous plates. The anal funnel is 1 mm. high.

Locality.—East of the Channel; 146 meters; August 1, 1914.

Notes.—The cirri are XI, 8–9, from 2.5 to 3 mm. long. The radials are four times as broad as long. The IBr_1 are twice as broad as long. The IBr_2 (axillaries) are half again as broad as long. There is 1 IIBr 4 series. There are 11 arms, with very serrate brachials. The comb on P_1 has 4–5 teeth. P_2 is missing. The disk is coarsely granulated with calcareous grains and plates, and small oral plates are present. Gislén says that this is probably a young *Comaster*.

In another specimen from the same station the cirri are XIII, 10–11, from 2 to 2.5 mm. long. The radials are twice as broad as long. The IBr_1 are half again as broad as long. The 10 arms are about 10 mm. long. The arm bases are serrate. The comb of P_1 is rolled into a tight ball; it consists of a few (probably 5 or 6) teeth. P_2, P_3 and P_4 are absent. The disk is 1.3 mm. in diameter. The mouth is central, and is surrounded by orals.

Locality.—East of Chichijima; 146 meters; July 31, 1914.

Notes.—The cirri are XIV, 9, strongly recurved. There is a single IIBr 4 (3+4) series and a single IIIBr 2 series. The 12 arms are 15 mm. long. P_1 and P_2, and perhaps P_3 also, have a short comb. The mouth is central. The anal cone is smooth. Gislén says that this is a species either of *Comantheria* or of *Comaster.*

Another specimen has the cirri XII, 8–9, about 2 mm. long. The fourth segment is the longest, three times as long as broad; the fifth and sixth segments are twice as long as broad; the antepenultimate segment is from half again to twice as long as broad. The radials are bandlike, four times as broad as long. The IBr_1 are three times as broad as long and are free laterally. There are 2 IIBr 4(3+4) series. The 12 arms are 14 mm. long. P_1 is 3 mm. long with a comb consisting of 6 high teeth. P_2 and P_3 are usually absent. The comb on P_a has 4 teeth. There are no combs on the distal pinnules. The disk is 2 mm. in diameter. The mouth and anal tube are subcentral. The anal funnel is papillated. Gislén suggests that this is probably a species of *Comaster.*

In a third specimen the cirri are XII, 9–10, from 2.5 to 4 mm. long. The 10 arms, which are 20 mm. long, are somewhat smoother than the arms in the preceding specimen. The comb on P_1 has 7 teeth, and that on P_a has 6 teeth. P_2 and P_3 are wanting. The mouth is a little displaced. The anal cone is strongly papillose. Gislén says that this probably represents a species of *Comaster.*

In another specimen the cirri are XIV, 8–11, from 2.5 to 4 mm. long. There are 2 IIBr 2 series. The comb of P_1 has 7 teeth. P_2 and P_3 are absent. The anal cone is papillated.

In a fifth example the cirri are XVII, 10–14, from 3 to 4.5 mm. long. The third and fourth segments are twice as broad as long. The 10 arms are 15 mm. long, of the serrate type. The comb on P_1 consists of 5 high teeth. P_2 and P_3 are absent.

A sixth specimen has the cirri IX, 7–9, from 2 to 2.5 mm. long. The 10 arms are 12 mm. long. The comb of P_1 has about 6 teeth. P_2 and P_3 are absent. The mouth is central.

In another example the cirri are XVI, 10. The 10 arms are 10 mm. long. P_2, P_3, and P_4 are absent.

In an eighth specimen the cirri are XVII, 8–9. The 10 arms are about 15 mm. long. The comb on P_1 consists of 9 teeth. P_2 is absent. P_3 is without a comb. The anal tube is smooth. Gislén suggests that this is perhaps a specimen of *Comissia minuta.*

In another specimen the cirri are XIII, 9–10, 3 mm. long. The 10 arms are all broken. The radials are concealed by the centrodorsal. The comb of P_1 consists of about 6 teeth. P_2 is rudimentary.

There are 9 additional specimens from this locality some of which, as determined by Gislén, belong to the subfamily Comasterinae (*Comaster* and *Comantheria*) while others are practically impossible to determine either with regard to subfamily or to genus.

Gislén tried to work out and establish some characters of systematic value for the determination of young comasterids, but remarked that this is a very difficult task, for the systematic characters in the comasterids, as in all comatulids, are based on the length, breadth, appearance, and order of magnitude of the calcareous ossicles which combined make up the skeleton of the animal, and these are very different in young and full-grown individuals. He made the following generalizations.

1. The cirri in all young forms correspond to a type about the same as that characteristic of *Comaster serrata* or *Comatella brachycirra;* that is, with about 10 segments of which the third and fourth are the longest—two or three times as long as broad.

2. The division series beyond the IBr series, which furnish characters important from the systematic viewpoint, have not yet appeared.

3. The younger the animal the greater the relative length of the proximal arm ossicles. This is still more true of the distal brachials. The distal ends of the brachials are serrate and everted.

4. The comb on the proximal pinnules, which affords very reliable characters in adolescent and full-grown specimens, tends at an early age to become reduced to a uniform type, all small individuals having combs with a few high and rather large teeth. The young of the species of *Comaster* have combs only on the proximal pinnules.

5. In the very earliest stages the disk has a central mouth and a marginal anal tube.

Gislén said that as a general rule young comasterids which have a gap in the series of proximal pinnules (excluding forms of the *Comatilia* type) are impossible to determine even with tolerable certainty. But from a comparative study of the characters presented by the disk it might be possible to determine certain fixed points for the appraisal of the systematic position of the animal.

The young of the species of *Comatella* and of the large species of *Comissia* have a central or subcentral mouth and a short, narrow, and inconspicuous anal tube. On the ventral side the skin is tightly stretched between the arms, giving the disk a characteristically lean appearance. The young of *Comissia minuta* are also in the early stages recognizable by having the ambulacral furrows surrounded with cushion-shaped slopes, probably indicating the extension of the gonads on to the disk, and this condition, together with the characteristic proximal brachials which even at an early stage are very short, the coarse pinnule bases soon thickened by the genital glands, and the smooth proximal portion of the arms, makes them fairly easy to distinguish from young individuals of other species.

The young of *Comaster* and of *Comantheria* in the early stages also have a swollen disk. The anal tube is large, thick and coarse, a little swollen, and often (especially in *Comantheria delicata*) strongly papillated or plated. In the species of *Comaster* the lengthening of the anal tube soon ceases, and in large individuals the tube acquires a characteristic wartlike appearance, while in *Comantheria* it continues to lengthen into a long large chimney. In smaller young forms the mouth is central, but, except in *Comaster serrata*, it soon becomes displaced marginally.

Gislén said that the young of the subgenus *Comanthus* has, if his determination is correct, a rather long unswollen anal cone and a tolerably lean disk.

He concludes that naturally the fixed points obtainable by an examination of the disk are only to be used together with the other characteristics which are found. If, however, in the comparison and systematizing of the comasterid young one takes into consideration the appearance and formation of the disk, he believes that we shall be able to predict with greater probability than otherwise to which species or genus he young comasterid in question might be referred.

UNIDENTIFIABLE SPECIES

Locality.—*Albatross* station 3809; off the southern coast of Oahu, Hawaiian Islands; Honolulu Light bearing N. 2° E., 2.4 miles distant; 97–386 meters; bottom temperature 8.72° C.; fine coral sand; March 27, 1902.

Remarks.—A number of comasterid pentacrinoids were dredged at this station, some of which were attached to a cirrus probably of a species of Comactiniinae.

This is the only record of a comasterid from the Hawaiian Islands, and is especially interesting when considered in connection with the uncertain record of *Comatula solaris* from the Society Islands.

COMATULA MONILIS, COMATULA POLYACTINIA, COMATULA MONILIFORMIS, COMATULA INSERTA, AND COMATULA ACTINODES

Comatula monilis, C. polyactinia, C. moniliformis, C. inserta, C. actinodes Dujardin and Hupé, Hist. nat. des zoophytes, Echinodèrmes, 1862, p. 208.—A. H. Clark, Bull. du mus. d'hist. nat., Paris, 1911, No. 4, pp. 245, 246 [*polyactinis* instead of *polyactinia*]; Crinoids of the Indian Ocean, 1912, p. 283.

MM. Dujardin and Hupé listed these species as being contained in the collection of the Paris Museum. The names are *nomina nuda* as given by them, and there are no other references to them.

During my visit to the Paris Museum in 1910 I made a careful search for these names on the labels with the specimens, but was unable to find any of them, although I did find several of the other names similarly mentioned by Dujardin and Hupé.

COMATULA TRIQUETA

Comatula triqueta (Lütken, MS.) von Graff, Das Genus *Myzostoma*, 1877, pp. 12–16, 18, 22, 23, 72, 79.—Keller, Das Leben des Meeres, Leipzig, 1895, p. 106.

Antedon triqueta von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 19, 32, 47, 48, 54, 55 (Bohol, Philippines; myzostomes).

There is no clue to the identity of this form. Von Graff's first reference is to a specimen brought by the Godeffroy Co. from the East Indies. His second reference is to a specimen or specimens collected by Prof. Carl Semper and named by Carpenter.

ACTINOMETRA, sp.

Actinometra P. H. Carpenter, Trans. Linn. Soc. (Zoöl.), ser. 2, vol. 2, pt. 1, December, 1879, p. 7.

Carpenter remarked that the foreign specimen dissected by de Blainville "would seem to have been a true *Actinometra* [comasterid]."

ACTINOMETRA, spp.

Actinometra P. H. Carpenter, Bull. Mus. Comp. Zoöl., vol. 9, No. 4, p. 154.

Doctor Carpenter here noted that *Actinometra cumingii* and two or three undescribed species from China, Japan, and Sumatra are the only 10-armed comasterids in the Eastern Hemisphere which do not belong to the *solaris* type.

Actinometra cumingii is the young of *Comatula pectinata*. The species from China probably refers to a specimen of *Comactinia echinoptera* erroneously labeled Hong Kong which was sent to Carpenter from the Museum of Comparative Zoölogy at Cambridge, Mass., with the *Blake* collection. The species from Japan may have been included in Professor Döderlein's collection, or it may refer to the type specimen of *Comatulides decameros* in the Copenhagen Museum. If it was in the Döderlein collection it was undoubtedly a species of *Comissia*. I have not been able to locate the specimen or specimens upon which the mention of Sumatra is based. Very few crinoids have ever been recorded from Sumatra.

ACTINOMETRA, spp.

Actinometra P. H. Carpenter, Quart. Journ. Microsc. Sci., vol. 27, 1887, p. 386.

Carpenter here says that there is no sign of sacculi in an *Actinometra* from a *Challenger* station near the Kei Islands, in 9 specimens from Cape York in the *Challenger* dredgings, or in specimens from 6 different *Blake* stations near Barbados, Montserrat, Martinique, and St. Vincent. The specimens referred to are all given under the proper species in the preceding pages.

ACTINOMETRA, n. sp.

Actinometra von Graff, *Challenger* Reports, Zoology, vol. 20, pt. 61, 1887, pp. 3, 9.

Professor von Graff described a myzostome from an undetermined species of *Actinometra* from the Moluccas.

ACTINOMETRA, sp.

Actinometra, sp. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 329.

Carpenter mentioned that a comasterid of the *Parvicirra* group is found at Tahiti. This is the only reference to this specimen.

ACTINOMETRA, spp.

Actinometra Bell, in Gardiner, Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 1, pt. 3, 1902, p. 225.

Professor Bell said:

> Genus *Actinometra*. Young forms were obtained off the coral masses of the west reef of Hulule. It is noticeable that neither this genus nor *Antedon* was found in the lagoon nor on the reefs of Minikoi.

ACTINOMETRA, spp.

Actinometra MacMunn, Quart. Journ. Microsc. Sci., new ser., vol. 30, 1890, p. 59.

The coloring matter of an "*Actinometra*" from Banda, and also of a "large *Actinometra*" from Banda, is discussed. These were 1 or 2 of the following species:

Capillaster sentosa.
Capillaster multiradiata.
Comaster multibrachiata.
Comantheria briareus.
Comanthina schlegelii.
Comanthus timorensis.
Comanthus parvicirra.

ACTINOMETRA, sp.

Actinometra, sp. Walther, Einleitung in die Geologie als historische Wissenschaft, 1894, p. 298.

Walther records an "*Actinometra*" as very common at Somerset, Queensland, in 15–22 meters. Both *Comatula rotalaria* and *C. solaris* are very common here, and the reference is probably to one or other, or both, of these.

COMATULES

Comatules Ferussac, Bull. des sci. nat., ser. 2, vol. 26, 1831, p. 183.

Ferussac here records that M. Lemare-Picquot brought home numerous comatulids from his voyage to the East Indies and South Africa.

COMATULA, sp.

Comatula von Willemoes-Suhm, Zeitschr. f. wiss. Zool., vol. 25, 1875, p. xxxi; vol. 26, 1876, p. lxxix.

In the first reference we read:

> Den kleinen Parasiten der *Comatula*, *Myzostomum*, fanden wir zuerst in Halifax [on *Heliometra glacialis*], und seitdem habe ich ihn oft bemerkt. Diesmal [between the Kermadec and Fiji Islands] aber unter eigenthümlichen Umständen unter denen er wohl noch nicht zur Beobachtung gekommen ist. Ich fand nämlich an den Armen einer *Comatula* aus 600 Faden Anschwellungen von der Grösse eines Schrotkornes No. 3. Eine kleine Öffnung führte ins Innere, das von einer zarten Haut ausgekleidet war, und hier fanden sich stets 2 Myzostomen, ein grosses Individuum, das viel dicker ist als irgend welche, die ich früher frei auf den Armen des Seesterns fand, und ein kleineres, das etwa nur ein Fünftel des vorigen misst.

The information in the second reference has already been given. (Vol. 1, pt. 2, p. 620.)

COMATULA, sp.

Comatula von Graff, Das Genus *Myzostoma*, 1877.

Professor von Graff described the myzostomes from two species of comatulids which had been collected by Semper near Bohol in the Philippines. One of these was No. 6 in the Semper collection. The other bore no distinguishing mark.

COMATULAE

Comatulae Nutting, Bull. Lab. Nat. Hist., Univ. Iowa, vol. 3, Nos. 1, 2, 1895, p. 74.

Professor Nutting said that on the *Pentacrinus* grounds off Habana, Cuba, "bright yellow Comatulae were fairly abundant, and white or nearly white Comatulae were also secured at this place. It occurs to me as possible that Lieutenant Commander Sigsbee may have had these in mind when giving the colors of the pentacrini."

Most of the comatulids referred to belong to the Comasteridae.

ANTEDON, sp.

Antedon, sp. Savile-Kent, The Great Barrier Reef of Australia, Its Products and Potentialities 1892, p. 43; pl. 11, figs. 7, 7A.

Savile-Kent says:

> Two other members of the same echinodermatous, or sea-urchin and starfish class, observed on the Palm Island reefs, are depicted in the same coloured plate. These are the two Feather-starfish, *Antedon* sp., represented by figs. 7 and 7A, clinging to the corallum of the Gorgonia in the right hand upper corner. In general form they resemble the English Featherstar, *Comatula rosacea;* but they possess about forty, in place of the ten, pinnate arms of the European type. The variety of hues exhibited by the Barrier Reef species are legion, running through every gradation of tints from pale yellow to rose-pink, deep crimson and black, and including every conceivable intermixture of those colours. One especially handsome racial variety of this feather-star, obtained at Thursday Island, had its fern-like arms resplendent with shades of old-gold and bronze-green.
>
> One of the individuals figured is shown as bright red with rather widely spaced narrow brown bands on the arms which do not extend to the pinnules. In the other the arms are brownish yellow banded with dark yellow brown and becoming brown basally. The pinnules are entirely bright yellow. The cirri are banded light and dark.

Undoubtedly Savile-Kent refers to the entire comatulid fauna of the Barrier Reef. But since *Comanthus timorensis* is much the commonest and most conspicuous of the multibrachiate species in this region, his remarks must be considered as referring chiefly, perhaps even entirely, to this form.

COMATULIDS

Antedonidae [Bather], Natural Science, vol. 13, 1898, p. 7.

On the coral reefs at Blaking Mati "the most striking forms are numberless Antedonidae." Doubtless all the littoral families of comatulids are included under this heading, but in such a situation the species of Comasteridae would far outnumber all other types.

LUNA MARINA ALTERA

Luna marina altera Seba, Thesaurus, vol. 3, 1761, pl. 9, fig. 4.—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 280.

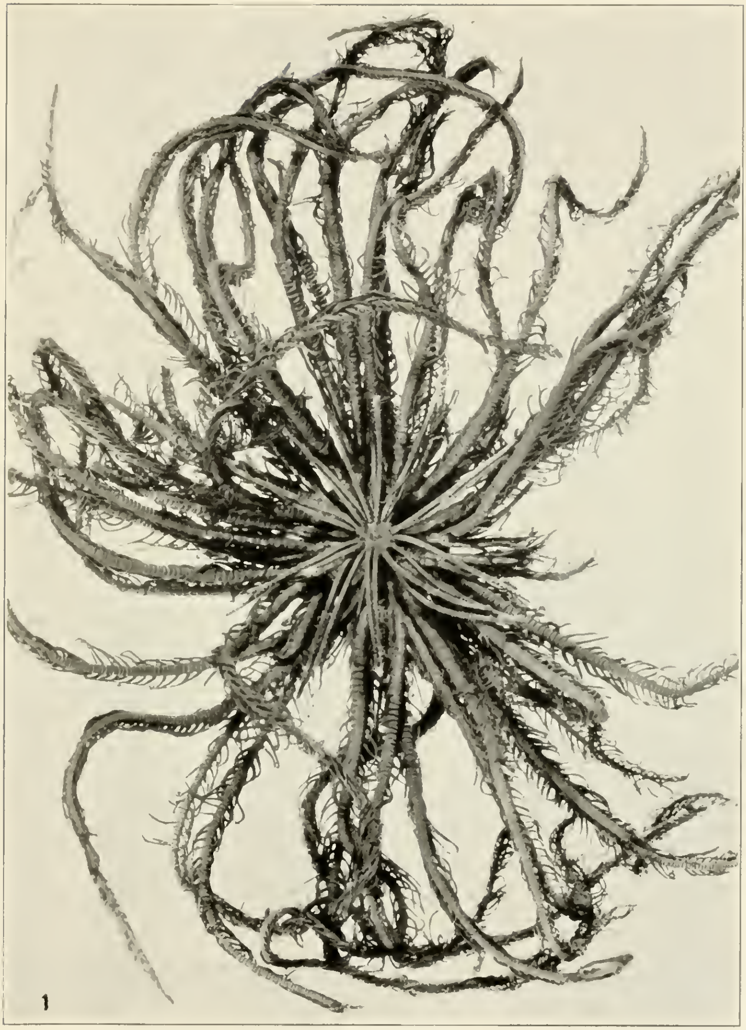
Seba gave no habitat for this form, which appears to be one of the Comasteridae. Linné referred it to his *Asterias pectinata*.

PLATES

EXPLANATION OF PLATES

PLATE 1

FIGURE 1. *Comatella nigra* from *Albatross* station 5147 (U.S.N.M., 34484).



COMATELLA NIGRA

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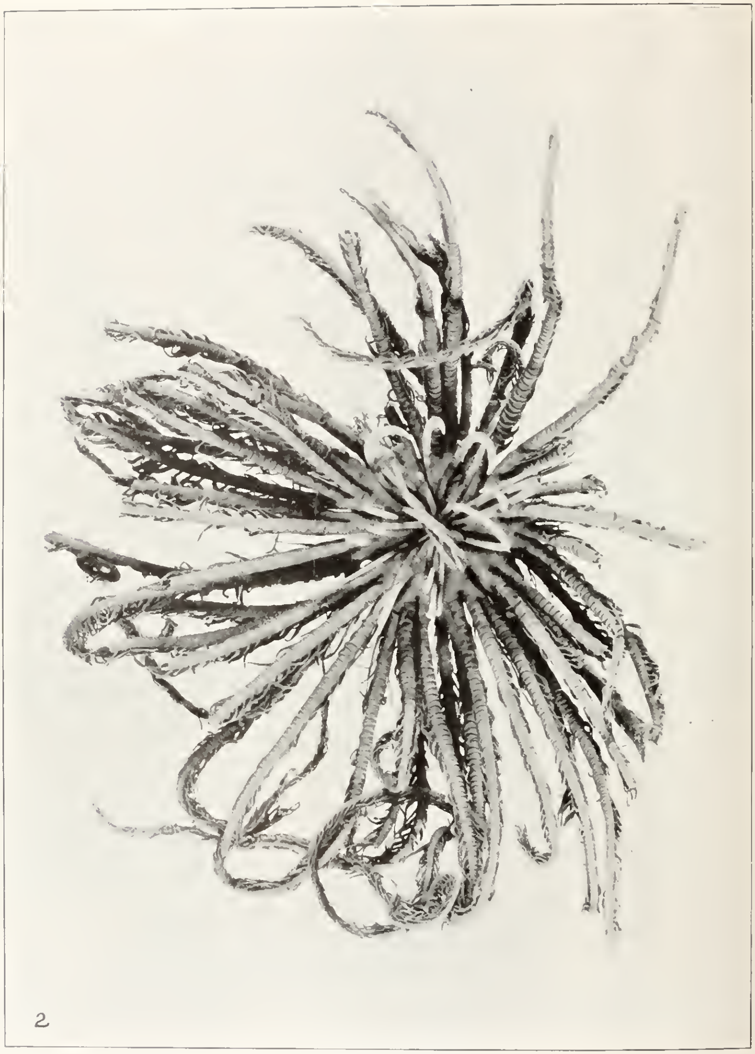

COMATELLA NIGRA

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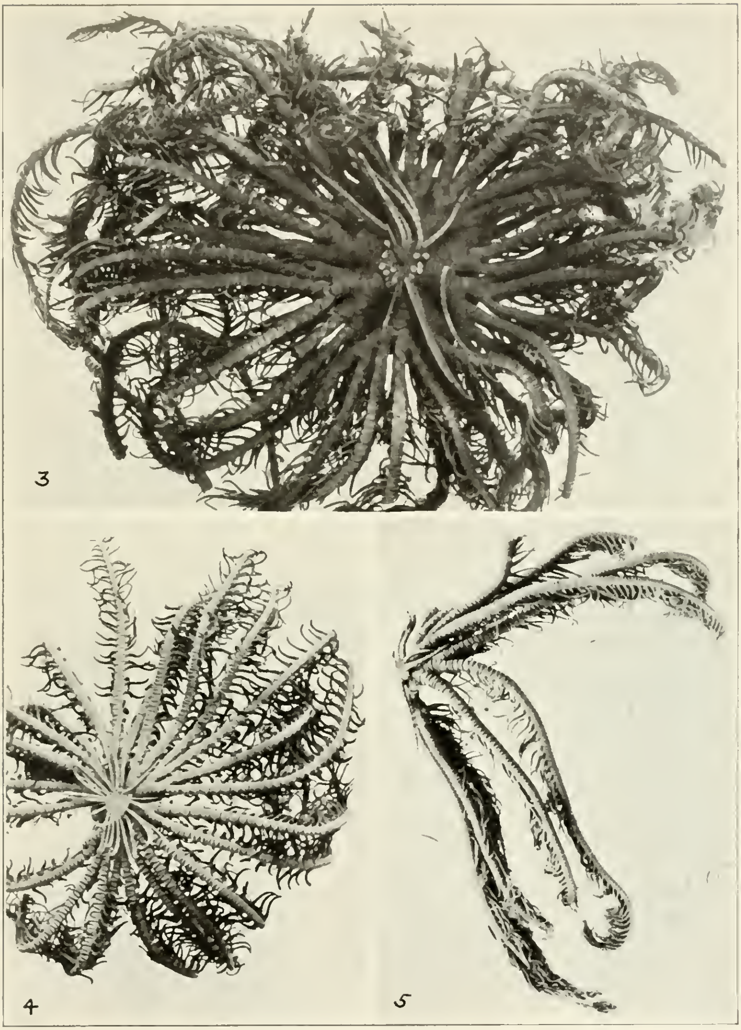
PLATE 2

FIGURE 2. *Comatella nigra* from *Albatross* station 5253 (U.S.N.M., 34492).

PLATE 3

FIGURE 3. *Comatella nigra* from the southern portion of the Malacca Straits (I. M.).
4. *Comanthus trichoptera* from Port Jackson, New South Wales.
5. *Capillaster multiradiata* from the Andaman Islands (I. M.).



Comatella nigra, Comanthus trichoptera, and Capillaster multiradiata

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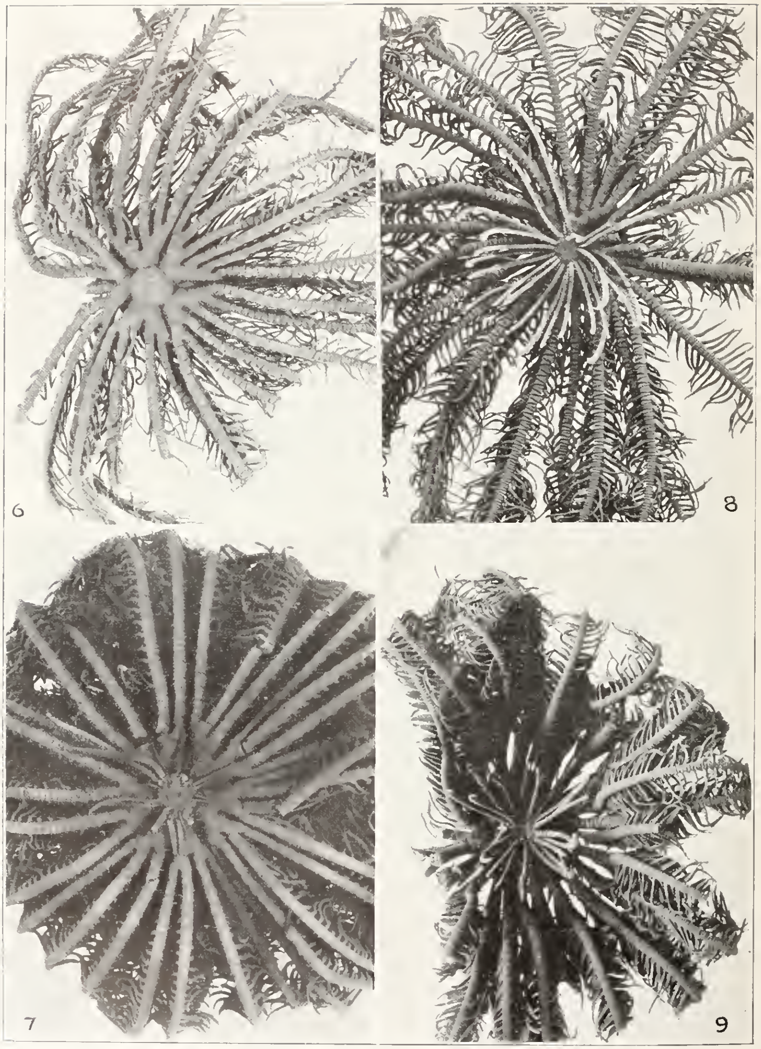


Comatella stelligera

For explanation of plate see page facing.

PLATE 4

FIGURE 6. *Comatella stelligera* from Padaw, Mergui Archipelago (U.S.N.M., 31195).

7. *Comatella stelligera* from "India" (probably Ceylon); *Investigator* collection No. 511 (I. M.).

8. *Comatella stelligera* from Samoa; a specimen labeled by Lütken *Antedon* (*Actinometra*) *tenax* (C. M.).

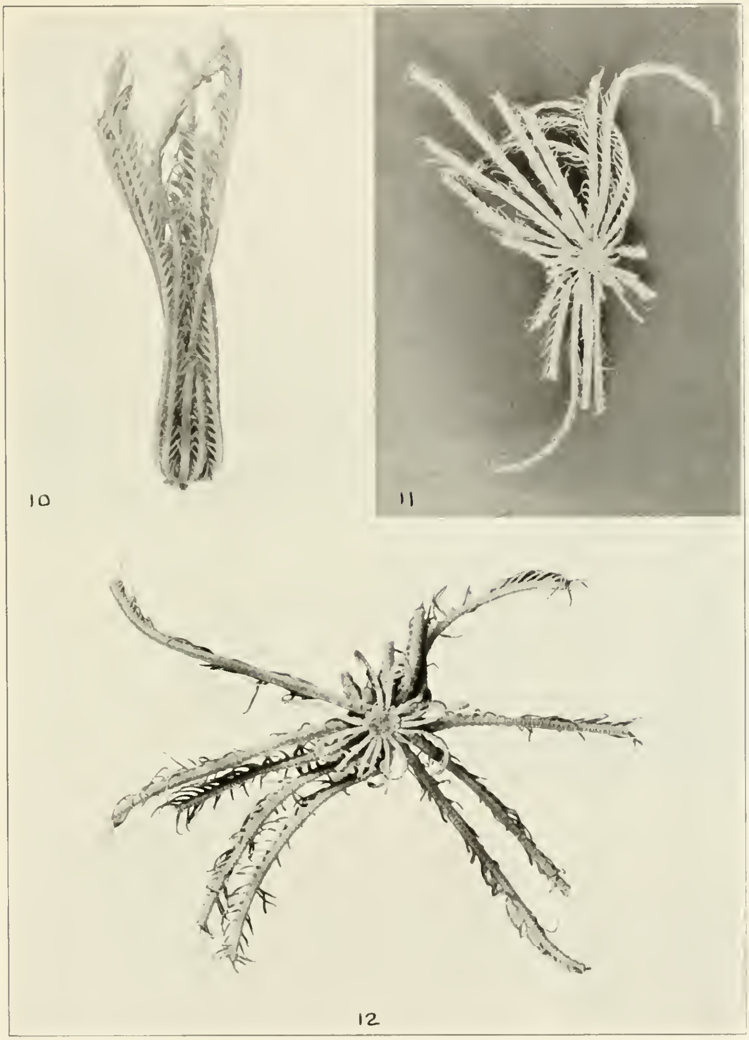
9. *Comatella stelligera* from Samoa; a specimen labeled by Lütken *Antedon* (*Actinometra*) *tenax* (C. M.).

PLATE 5

FIGURE 10. *Neocomatella pulchella* from *Albatross* station 2320 (U.S.N.M., 34468).

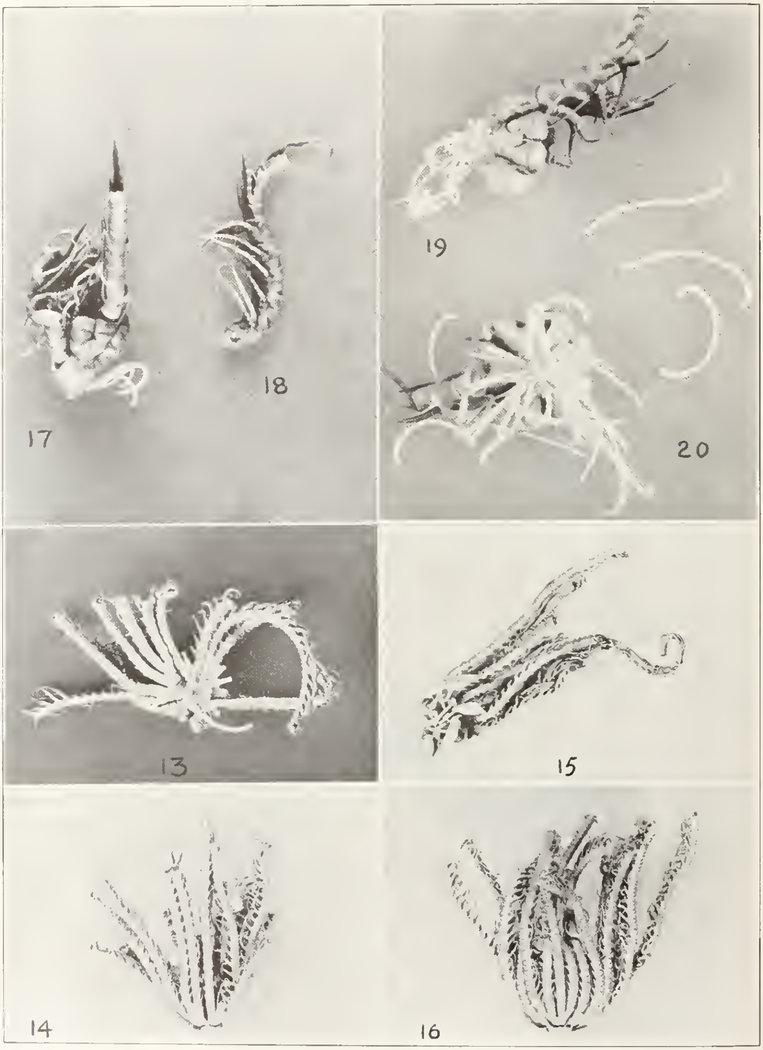
11. *Neocomatella pulchella* from *Blake* station 298 (U.S.N.M., 34481).

12. *Neocomatella pulchella* collected by the *Albatross* off Habana, Cuba, in 1886 (U.S.N.M., 34890).



Neocomatella pulchella

For explanation of plate see page facing.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Comatonia cristata and Neocomatella pulchella

For explanation of plate see page facing.

PLATE 6

FIGURE 13. *Neocomatella pulchella* from *Blake* station 298 (U.S.N.M., 34481).

14–16. *Neocomatella pulchella* from *Albatross* station 2354 (U.S.N.M., 34464).

17. *Comatonia cristata* from off Sambo Key, Fla., in 210 meters (U.S.N.M., E. 548).

18. *Comatonia cristata*, proximal portion of an arm from the preceding specimen.

19. *Comatonia cristata* from *Fish Hawk* station 7298 (U.S.N.M., 34628).

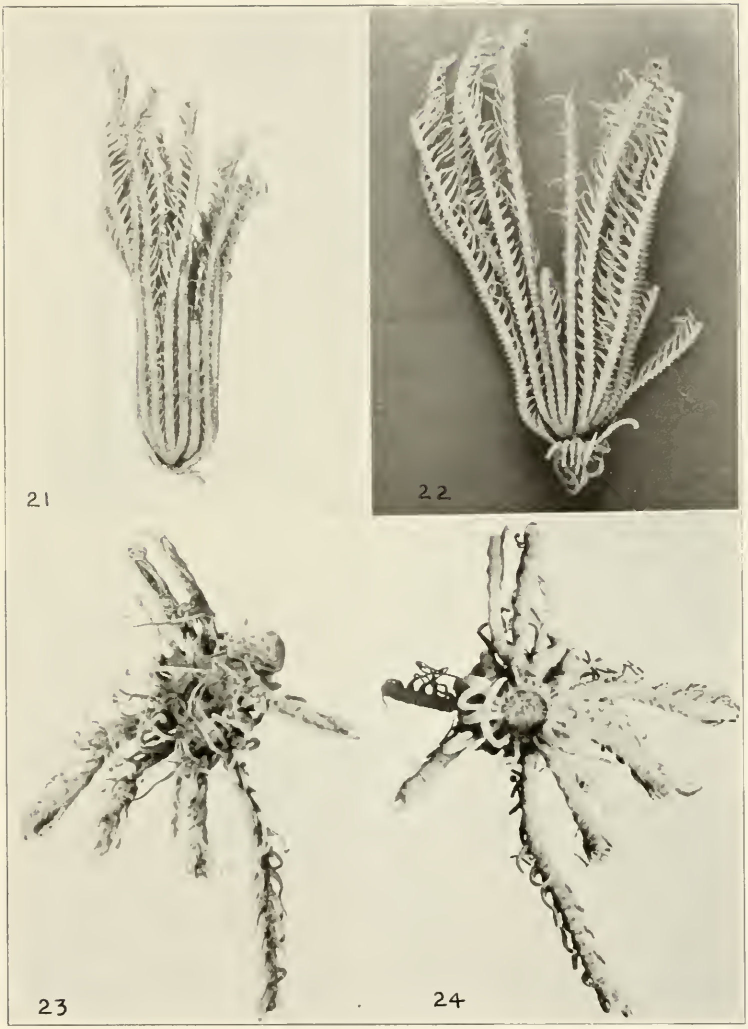
20. *Comatonia cristata* from *Fish Hawk* station 7302 (U.S.N.M., 34634).

PLATE 7

FIGURE 21. *Neocomatella pulchella* from *Albatross* station 2320 (U.S.N.M., 34468).

22. *Neocomatella alata:* the type specimen of *Neocomatella ornata* from *Albatross* station 2321 (U.S.N.M., 34482).

23, 24. *Palaeocomatella difficilis* from *Siboga* station 105, ×3 (Amsterdam Mus.).



NEOCOMATELLA PULCHELLA, N. ALATA, AND PALAEOCOMATELLA DIFFICILIS

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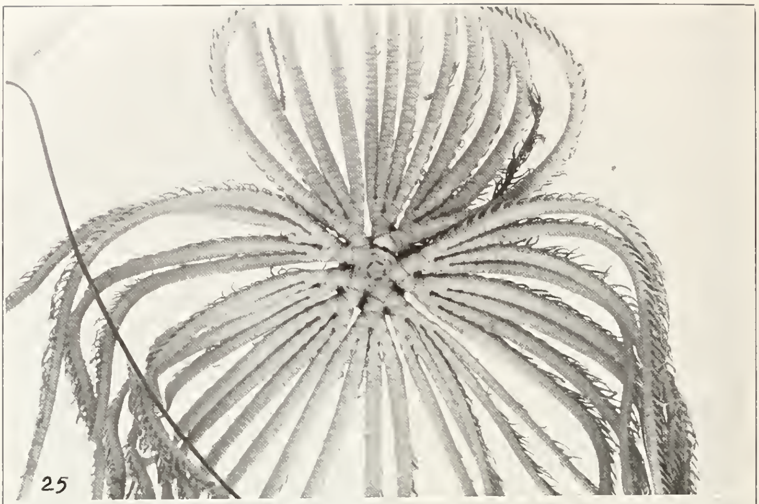
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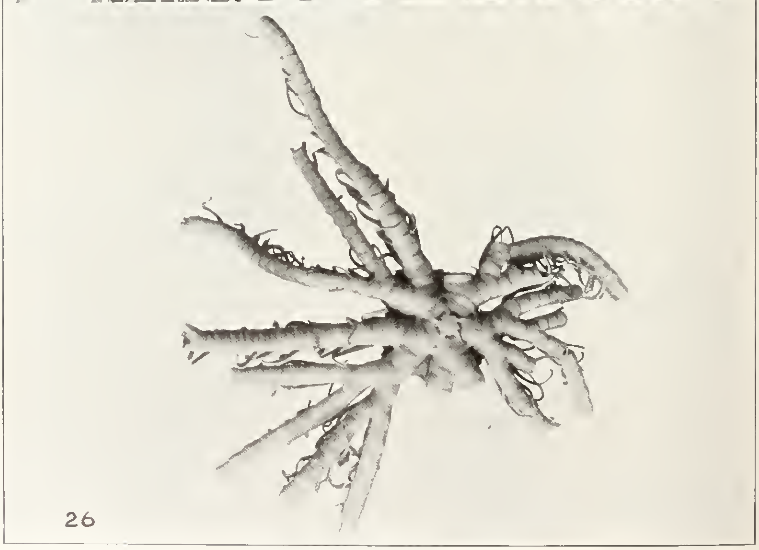
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Capillaster macrobrachius

For explanation of plate see page facing

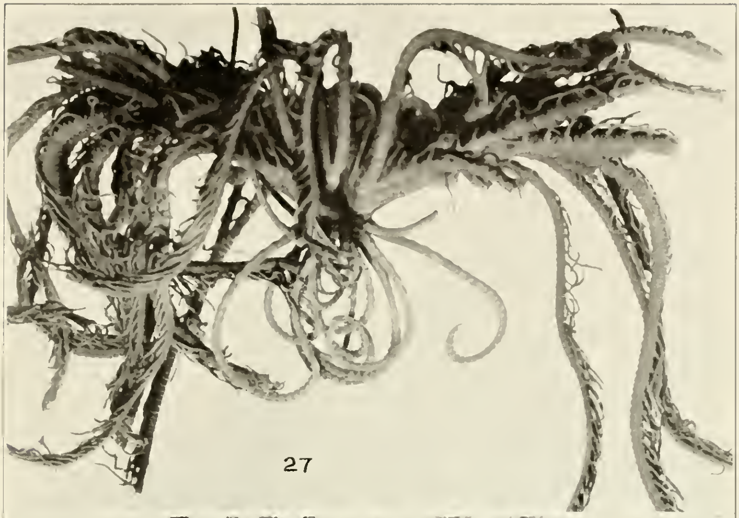
PLATE 8

FIGURE 25. *Capillaster macrobachius*, the type specimen from the China Sea (H. M.).
26. *Capillaster macrobrachius* from *Siboga* station 77, ×2 (Amsterdam Mus.).

PLATE 9

FIGURE 27. *Capillaster gracilicirra*, the type specimen from *Siboga* station 320, ×2 (Amsterdam Mus.).

28. *Capillaster sentosa* from Singapore (C. M.).



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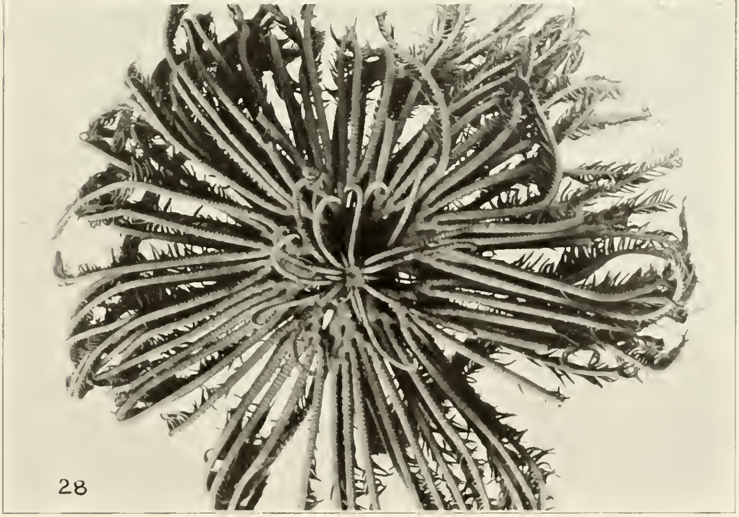

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CAPILLASTER GRACILICIRRA AND C SENTOSA

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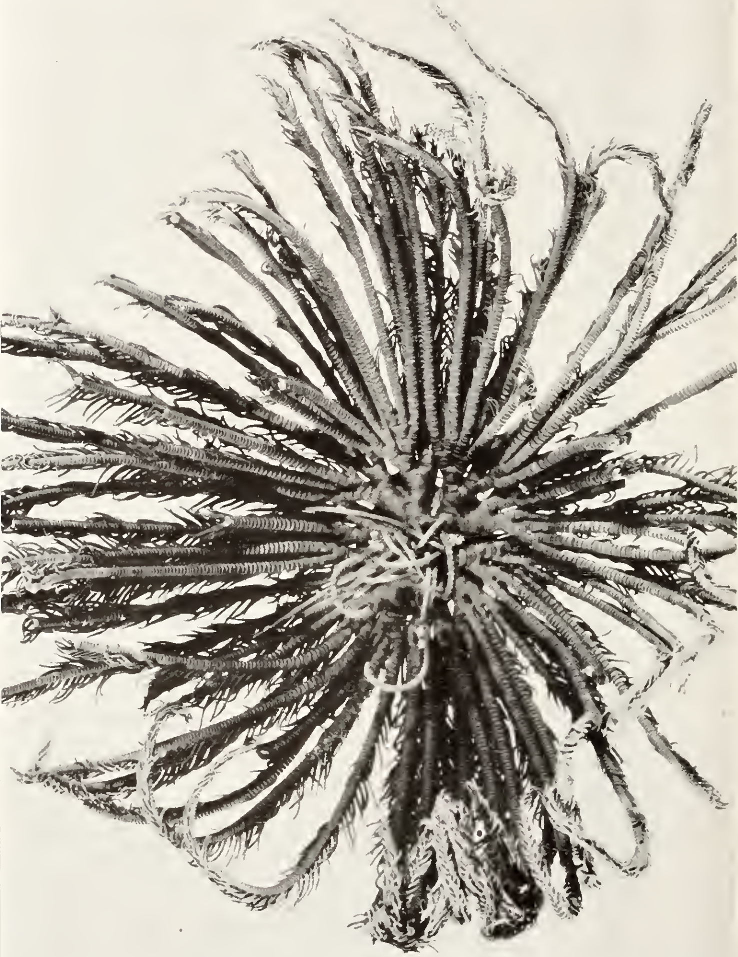

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CAPILLASTER SENTOSA

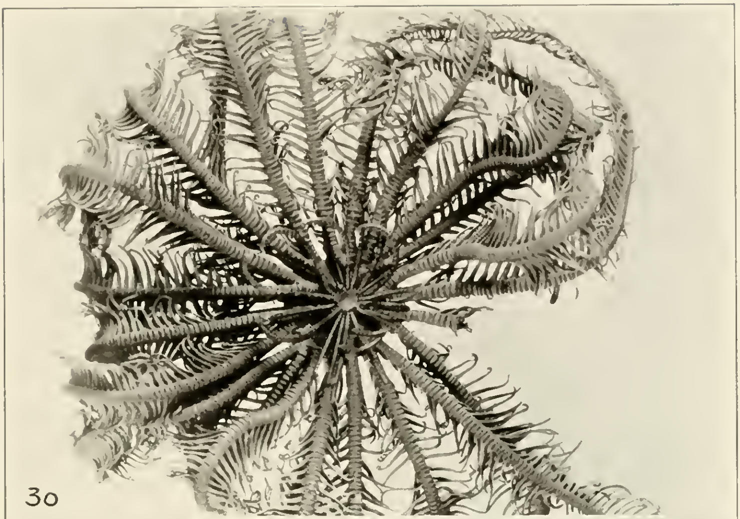
FOR EXPLANATION OF PLATE SEE PAGE FACING.

Plate 10

Figure 29. *Capillaster sentosa* from *Albatross* station 5146 (U.S.N.M., 34844).

Plate 11

Figure 30. *Capillaster multiradiata* from off Neira, Banda, in about 20 meters (C. M.).
31. *Capillaster sentosa* from Singapore (C. M.).



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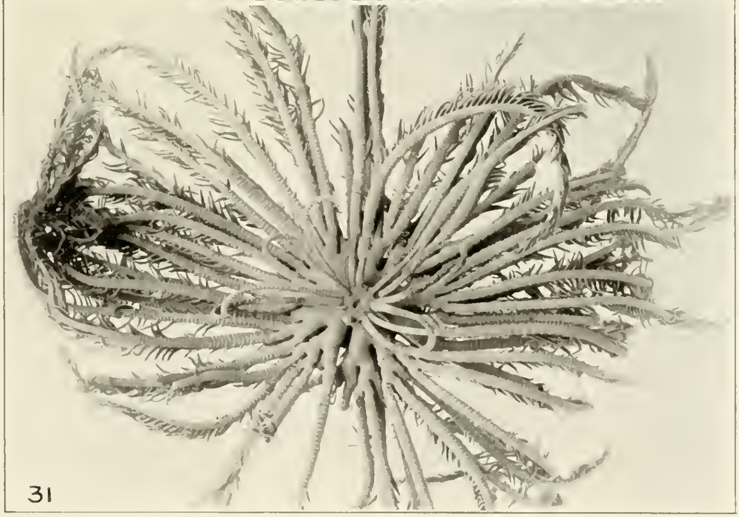

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CAPILLASTER MULTIRADIATA AND C. SENTOSA

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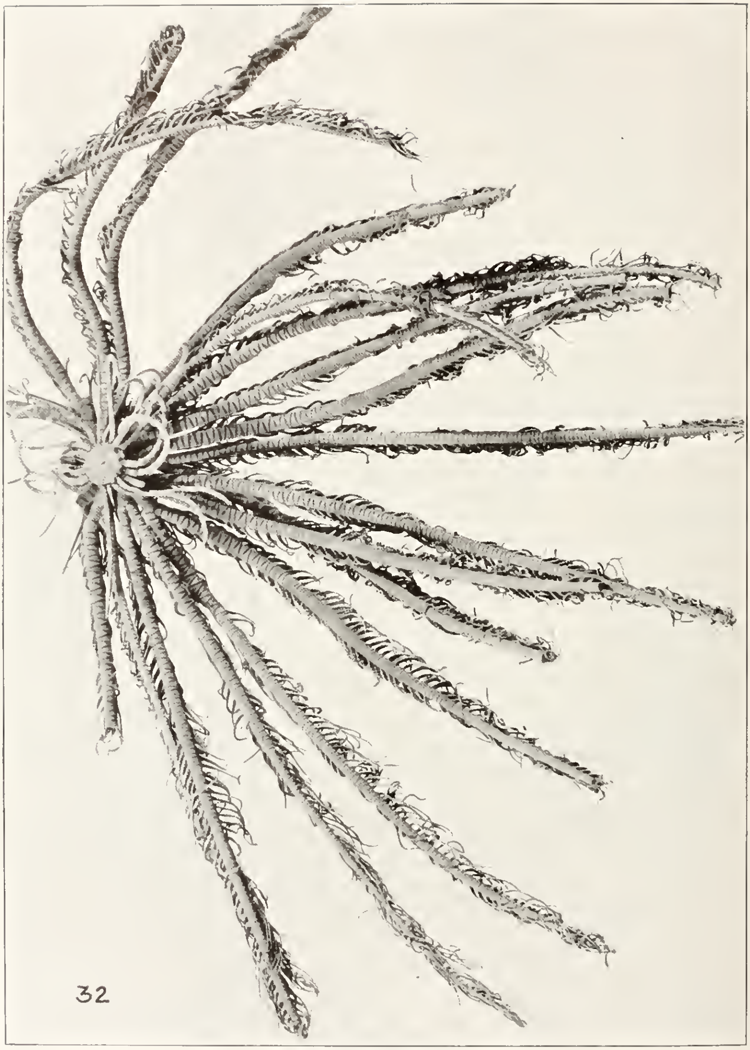

CAPILLASTER MARIAE

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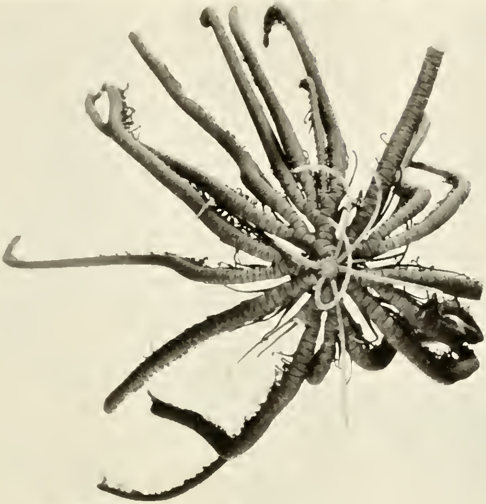
PLATE 12

FIGURE 32. *Capillaster mariae* from *Albatross* station 4880 (U.S.N.M., 22655)

Plate 13

Figure 33. *Capillaster asterias*, the type specimen from the Danish expedition to the Kei Islands station 82 (C. M.).

34. *Capillaster multiradiata*, a typical specimen from the Danish expedition to the Kei Islands station 30 (C. M.).



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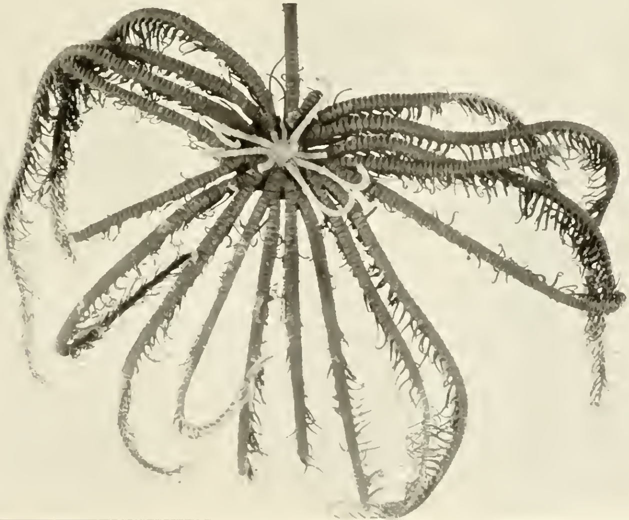

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Capillaster asterias and C. multiradiata

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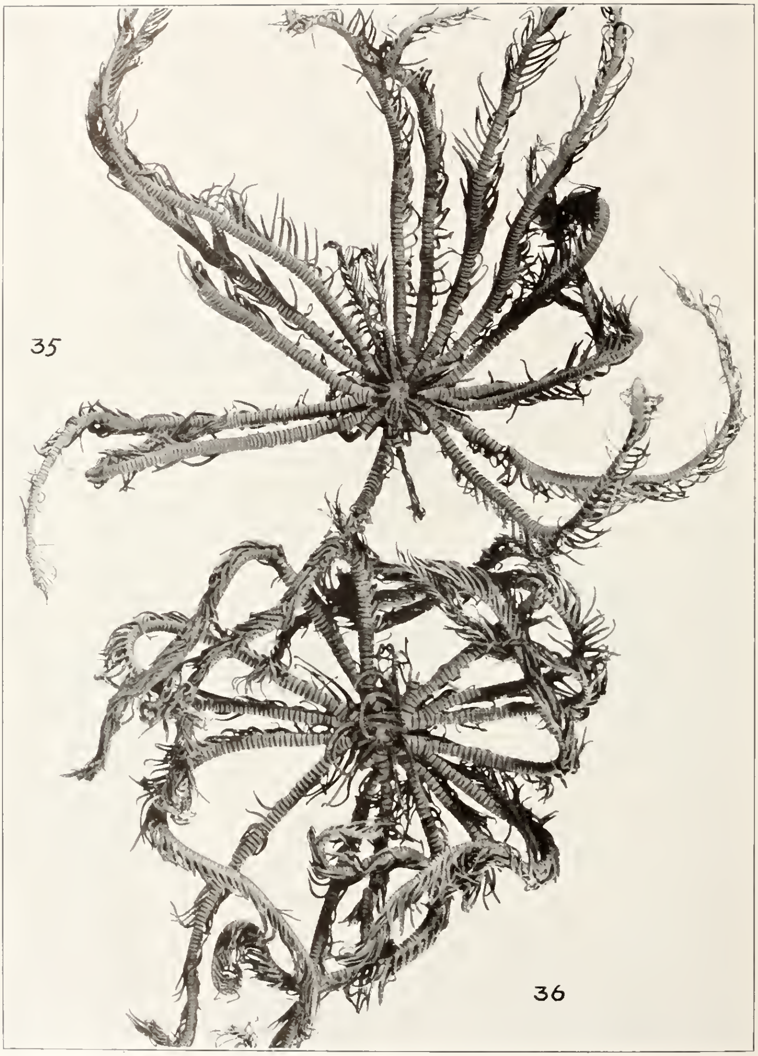

CAPILLASTER MULTIRADIATA

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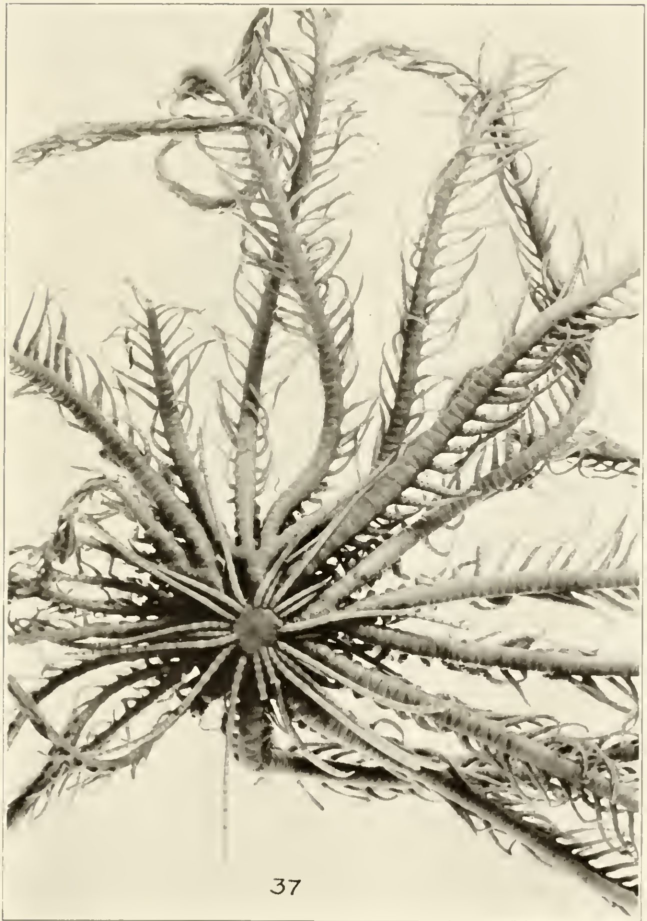
PLATE 14

FIGURES 35, 36. *Capillaster multiradiata* from *Albatross* station 5139 (U.S.N.M., 34957).

PLATE 15

FIGURE 37. *Capillaster tenuicirra*, the type specimen from *Siboga* station 320, ×2 (Amsterdam Mus.).



CAPILLASTER TENUICIRRA

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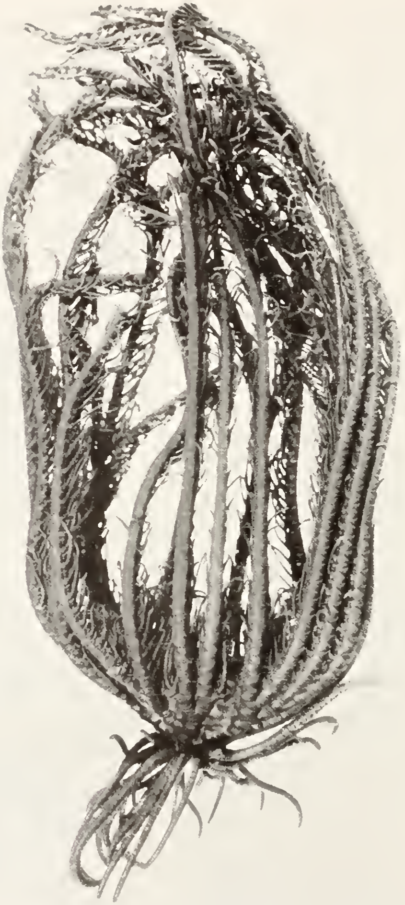

NEMASTER GRANDIS

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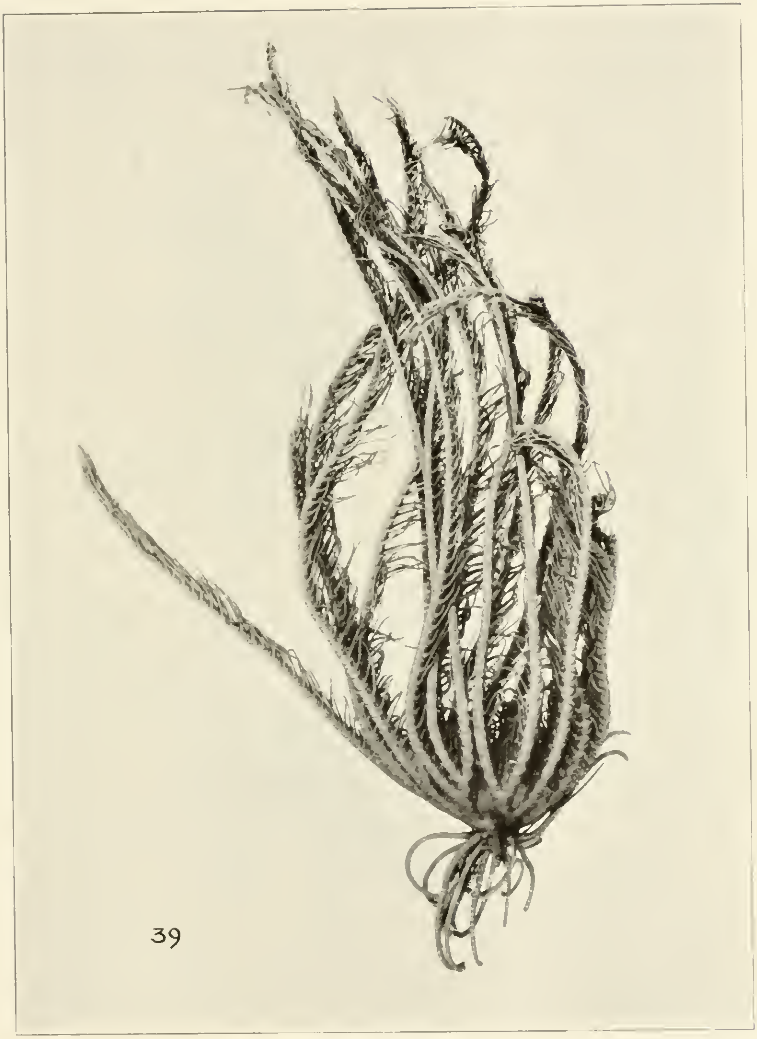
PLATE 16

FIGURE 38. *Nemaster grandis*, the type specimen from *Albatross* station 2146 (U.S.N.M., 25459).

PLATE 17

FIGURE 39. *Nemaster grandis* from *Albatross* station 2146 (U.S.N.M., 25459.)



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NEMASTER GRANDIS

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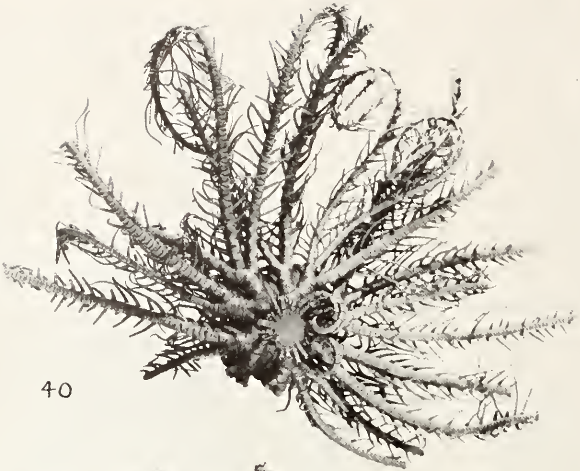

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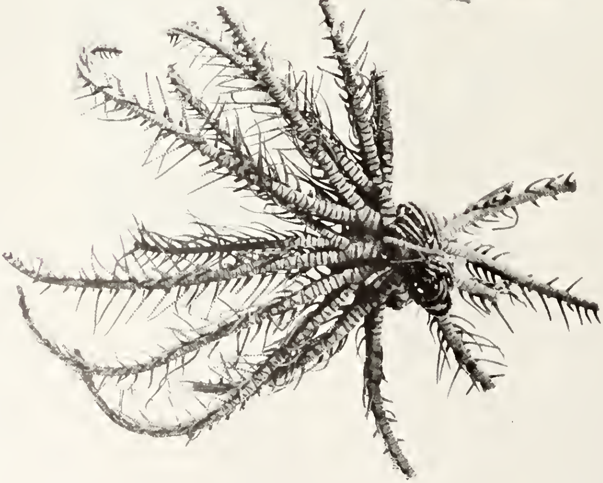

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Nemaster iowensis

For explanation of plate see page facing.

PLATE 18

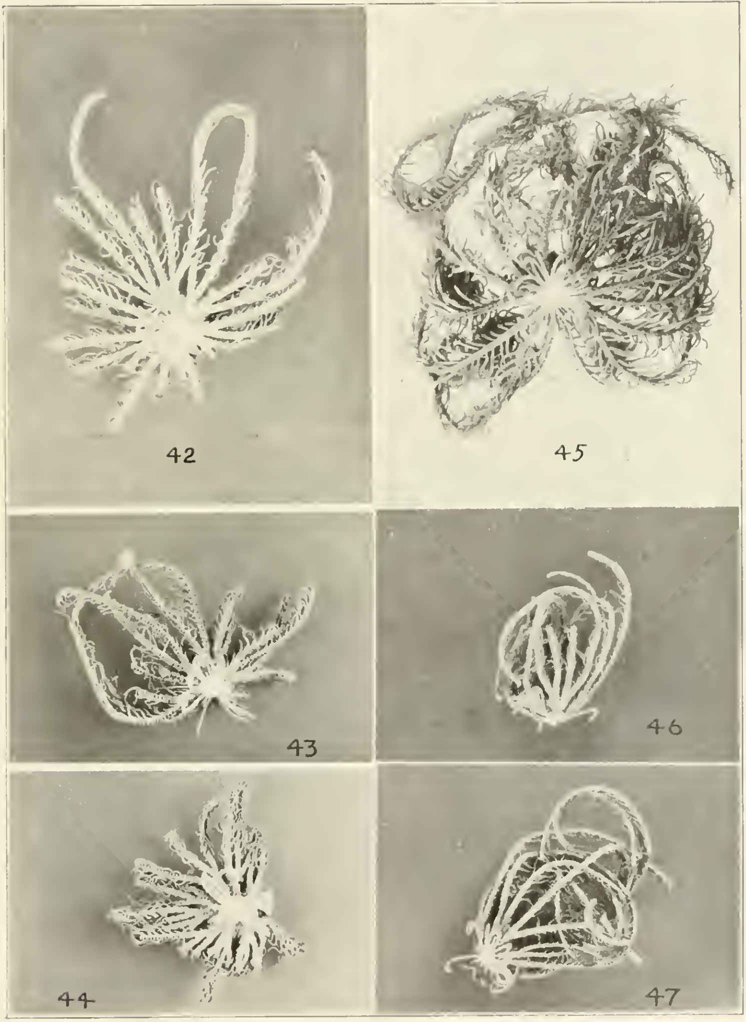
FIGURES 40, 41. *Nemaster iowensis*, the cotypes from the Dry Tortugas, Fla. (U.S.N.M., 34496)

PLATE 19

FIGURES 42–44. *Nemaster rubiginosa*, specimens collected by the *Challenger* at Bahia, Brazil (U.S.N.M., 17528).

45. *Nemaster rubiginosa* from off the western end of Thatch Island, Virgin Islands (C. M.).

46, 47. *Nemaster discoidea* from *Albatross* station 2326 (U.S.N.M., 34534).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NEMASTER RUBIGINOSA AND N. DISCOIDEA

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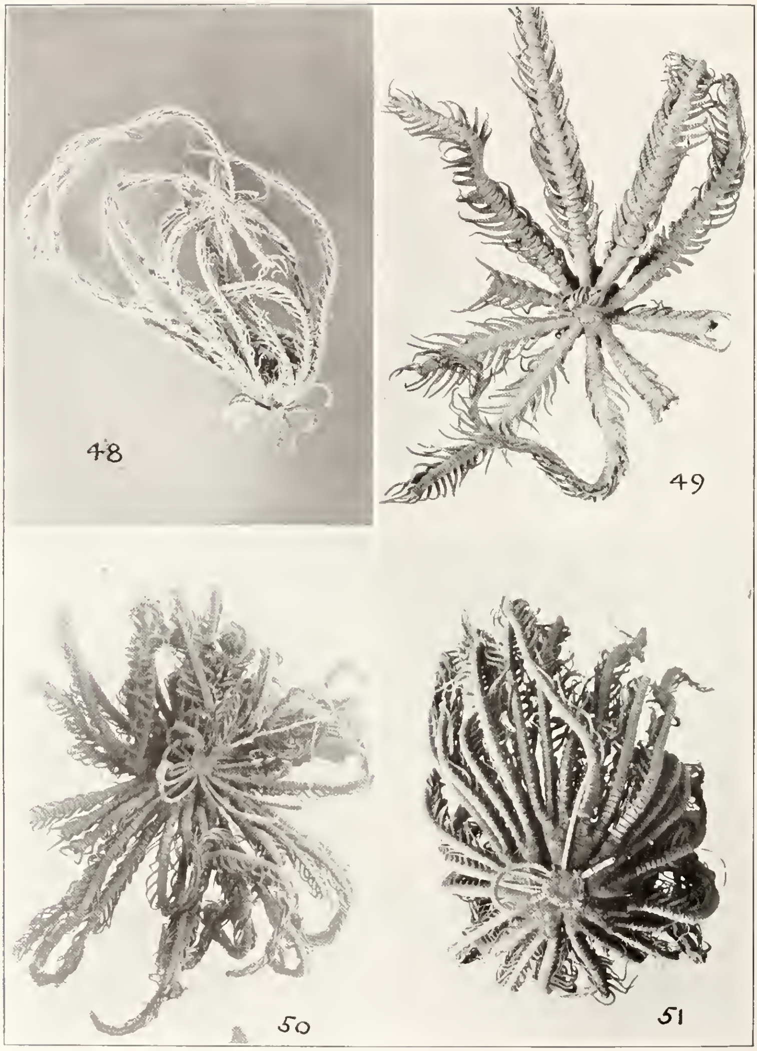


Nemaster discoidea, Comatella pectinata, C. maculata, and Comanthus solaster

For explanation of plate see page facing.

Plate 20

Figure 48. *Nemaster discoidea*, the type specimen of *Nemaster insolitus* from *Albatross* station 2146 (U.S.N.M., 25458).

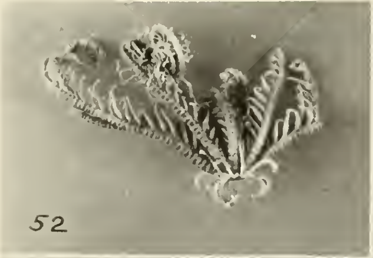
49. *Comatula pectinata* from *Albatross* station 5142 (U.S.N.M., 34924).

50. *Comatella maculata* from Japan.

51. *Comanthus solaster*, the type specimen from *Albatross* station 1911 (U.S.N.M., 22656).

Plate 21

Figures 52–57. *Comanthoides spanoschistum*, collected by the *Endeavour* off the Gippsland coast.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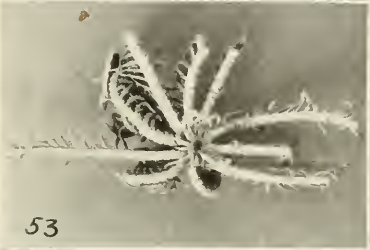
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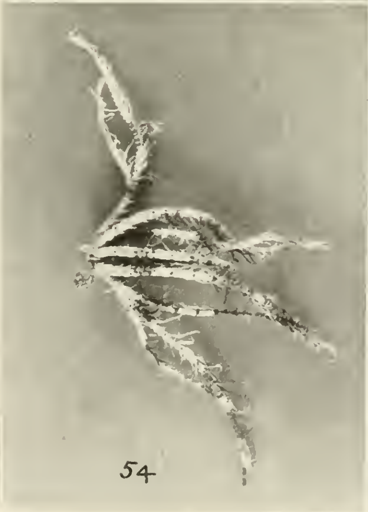
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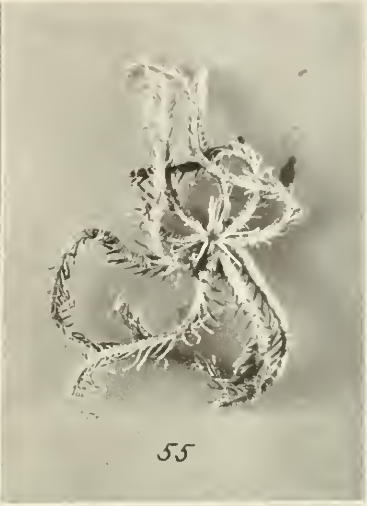
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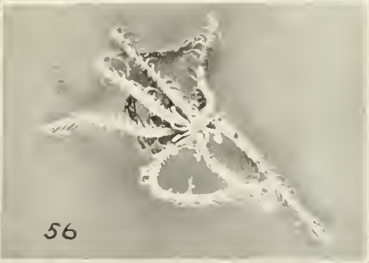
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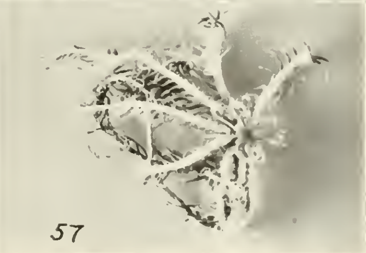
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COMANTHOIDES SPANOSCHISTUM

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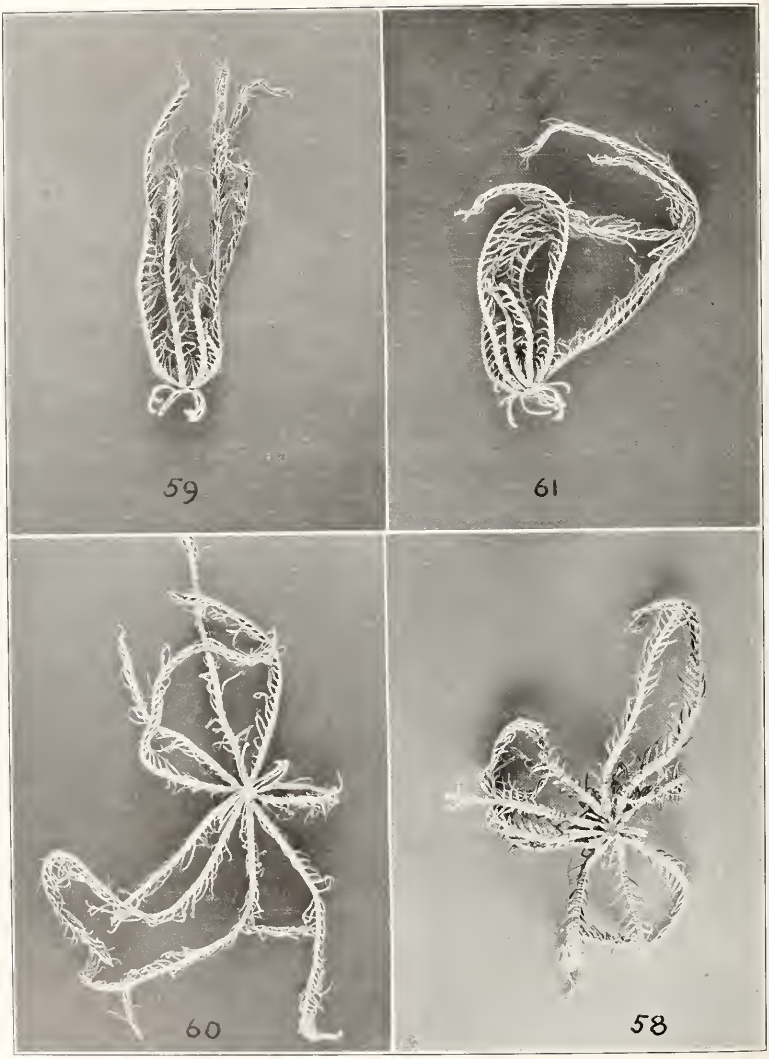

LEPTONEMASTER VENUSTUS AND COMANTHOIDES SPANOSCHISTUM

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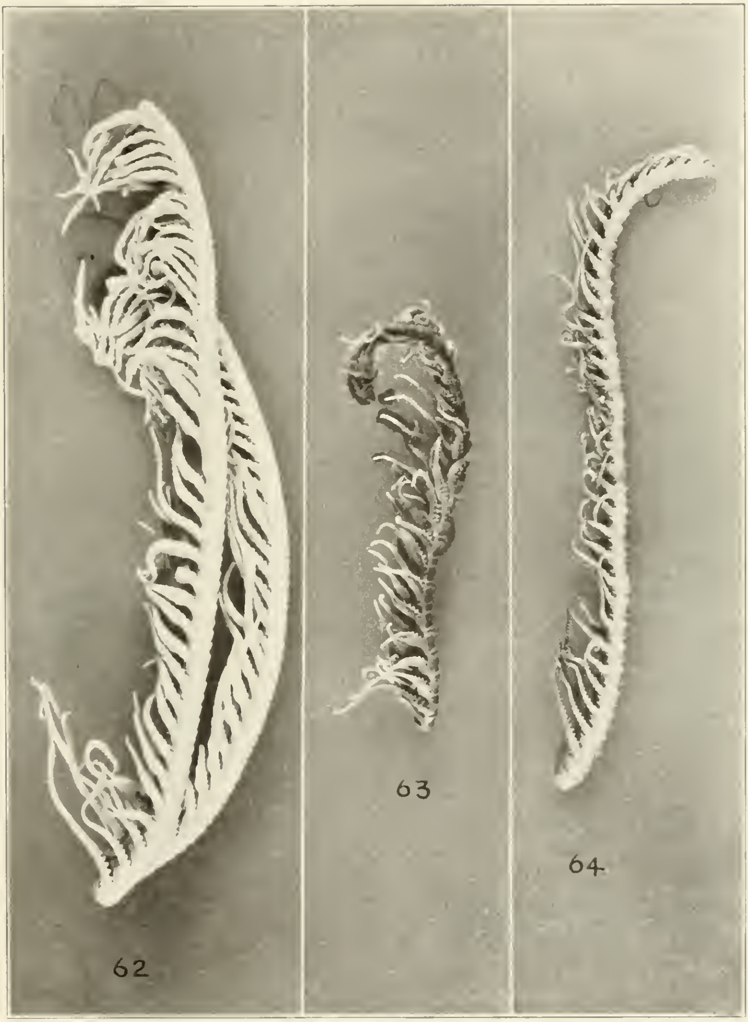
PLATE 22

FIGURE 58.—*Comanthoides spanoschistum*, collected by the *Endeavour* off the Gippsland coast.
59–61. *Leptonemaster venustus* from *Grampus* station 5104 (U.S.N.M., 25157).

Plate 23

Figure 62. *Comanthus plectrophorum*, a detached arm pair, ×2.
63. *Comanthoides spanoschistum*, a detached arm, ×2.
64. *Neocomatella pulchella*, a detached arm, ×2.



COMANTHUS PLECTROPHORUM, COMANTHOIDES SPANOSCHISTUM, AND NEOCOMATELLA PULCHELLA

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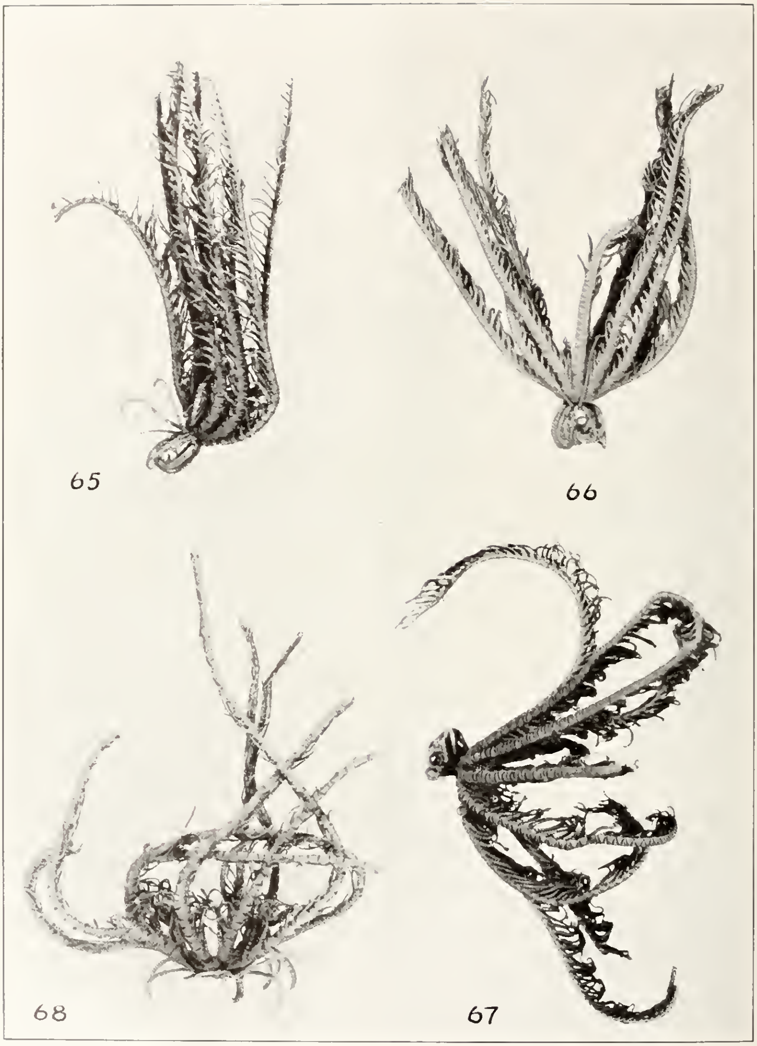

COMISSIA PEREGRINA, C. LÜTKENI, AND C. HORRIDUS

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PLATE 24

FIGURE 65. *Comissia peregrina*, the type specimen of *Comissia dumetum* from *Albatross* station 5356 (U.S.N.M., 27184).

66. *Comissia lütkeni*, the type specimen from *Albatross* station 5153 (U.S.N.M., 25513).

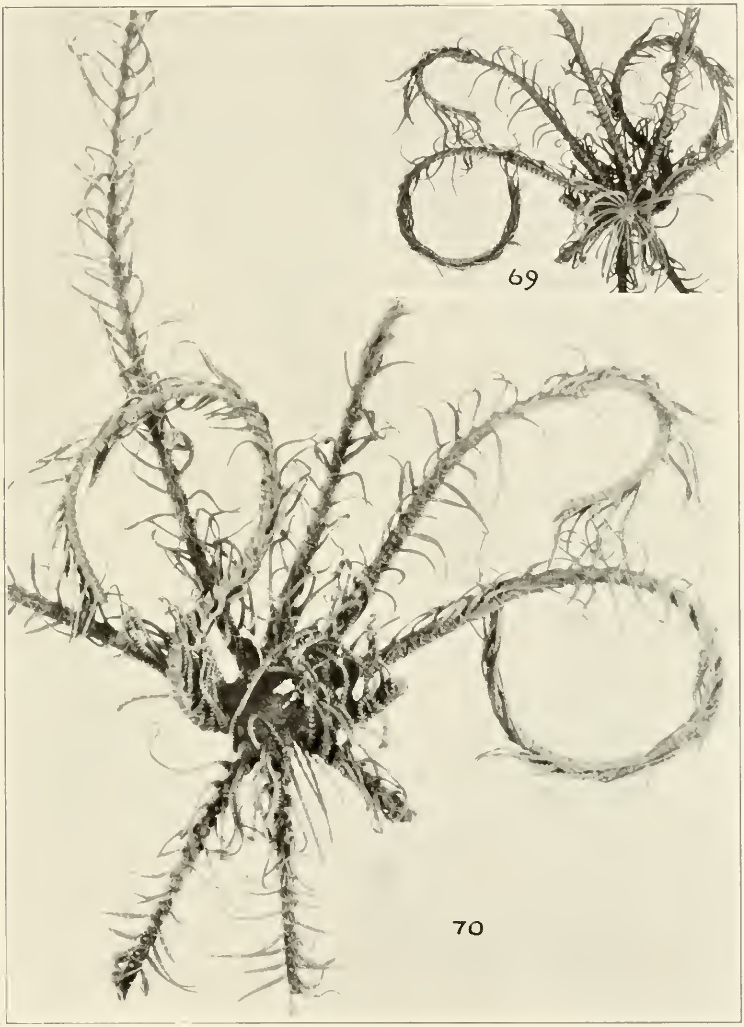
67. *Comissia lütkeni* from *Albatross* station 5483 (U.S.N.M., 34915).

68. *Comissia horridus*, the type specimen from *Albatross* station 5356, ×2 (U.S.N.M., 27487).

Plate 25

Figure 69. *Comissia pectinifer* from the Danish expedition to the Kei Island station 24 (C. M.).

70. *Comissia pectinifer*, the preceding specimen, ventral view, ×2 (C. M.).



COMISSIA PECTINIFER

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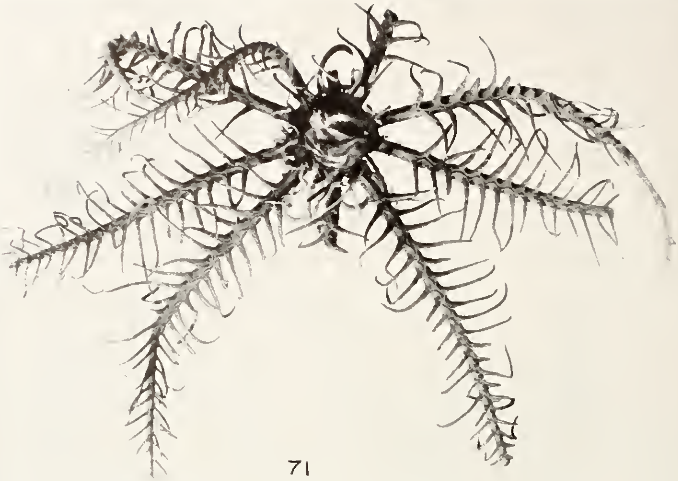

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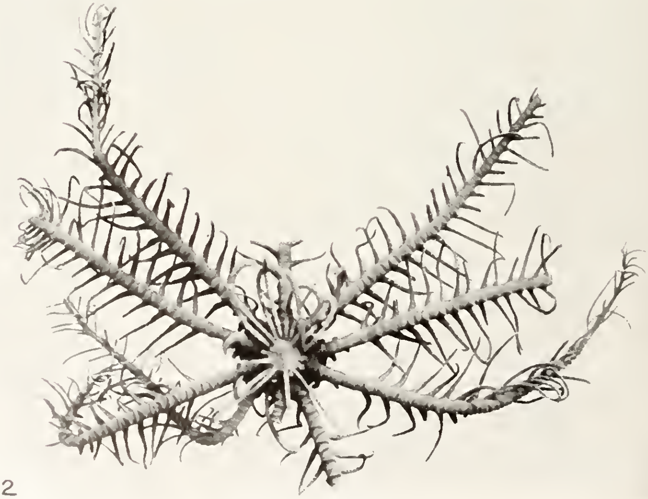

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Comissia littoralis

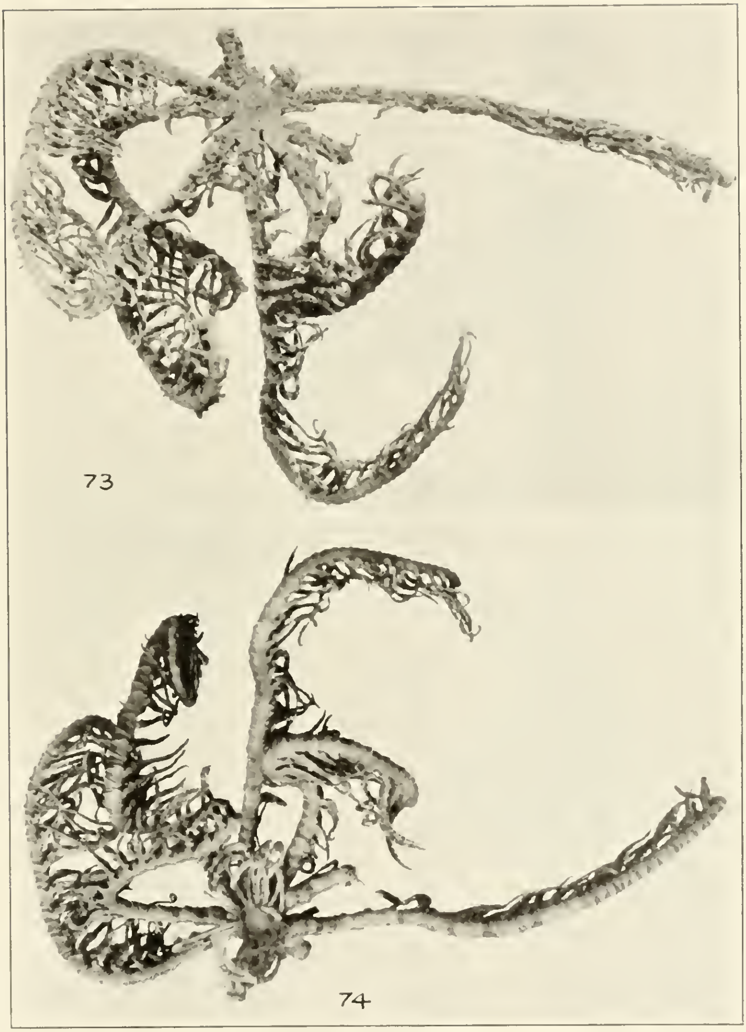
For explanation of plate see page facing.

PLATE 26

FIGURES 71, 72. *Comissia littoralis*, the type specimen from *Siboga* station 129, reef, × 2 (Amsterdam Mus.).

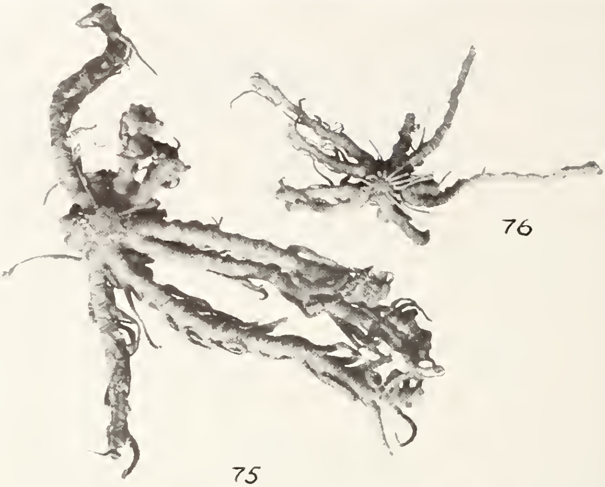
PLATE 27

73, 74. *Comissia spinosissima*, the type specimen from *Siboga* station 305, ×3 (Amsterdam Mus.).



Comissia spinosissima

For explanation of plate see page facing.



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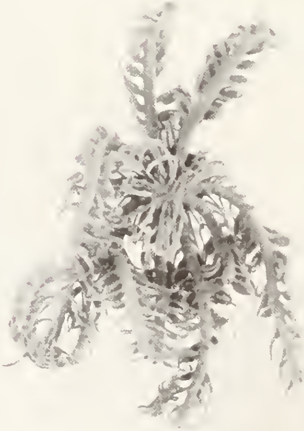

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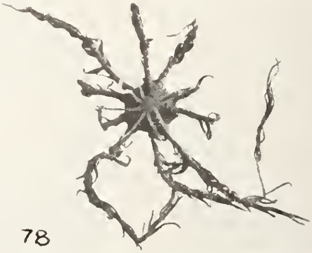

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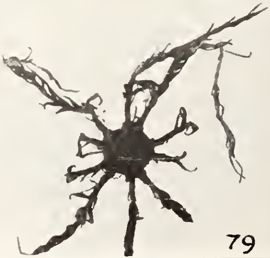

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COMISSIA GRACILIPES, C. PARVULA, AND C. HARTMEYERI

FOR EXPLANATION OF PLATE SEE PAGE FACING

PLATE 28

FIGURES 75, 76. *Comissia gracilipes*, cotypes from *Siboga* station 267, × 3 (Amsterdam Mus.).

77. *Comissia parvula*, the type specimen collected by the *Siboga* in the East Indies, × 3 (Amsterdam Mus.).

78, 79. *Comissia hartmeyeri*, the type specimen from Erg Tor, × 2 (Berl. M., 5349).

PLATE 29

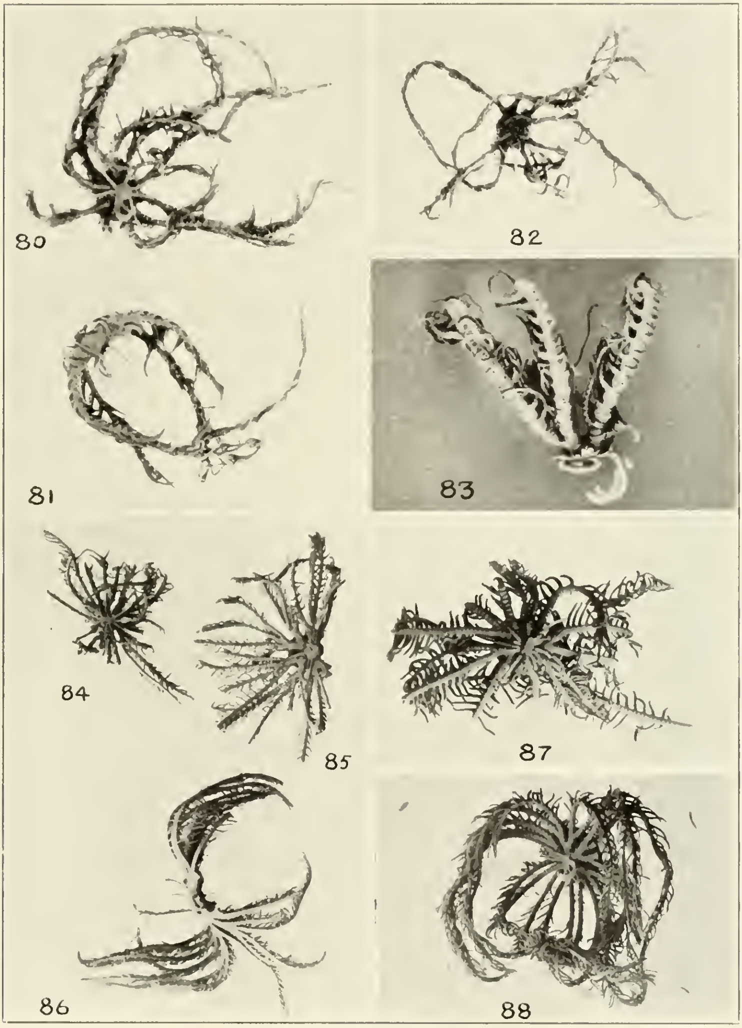
FIGURES 80-82. *Comissia hartmeyeri* from Erg Tor, ×2 (U.S.N.M., 34946).

83. *Comissia hispida*, the type specimen from *Albatross* station 5431 (U.S.N.M., 27485).

84-86. *Comaster brevicirra*, cotypes of *Comaster parvus* from the Andaman Islands collected by the *Investigator* (I. M.).

87. *Comantheria imbricata*, a young specimen from lat. 33° 08′ N., long. 129° 20′ E., in 65 meters (C. M.).

88. *Comanthus parvicirra*, a specimen from the Nicobar Islands labeled by Lütken *Comatula mutabilis* (C. M.).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COMISSIA HARTMEYERI, C. HISPIDA, COMASTER BREVICIRRA, COMANTHERIA IMBRICATA AND COMANTHUS PARVICIRRA

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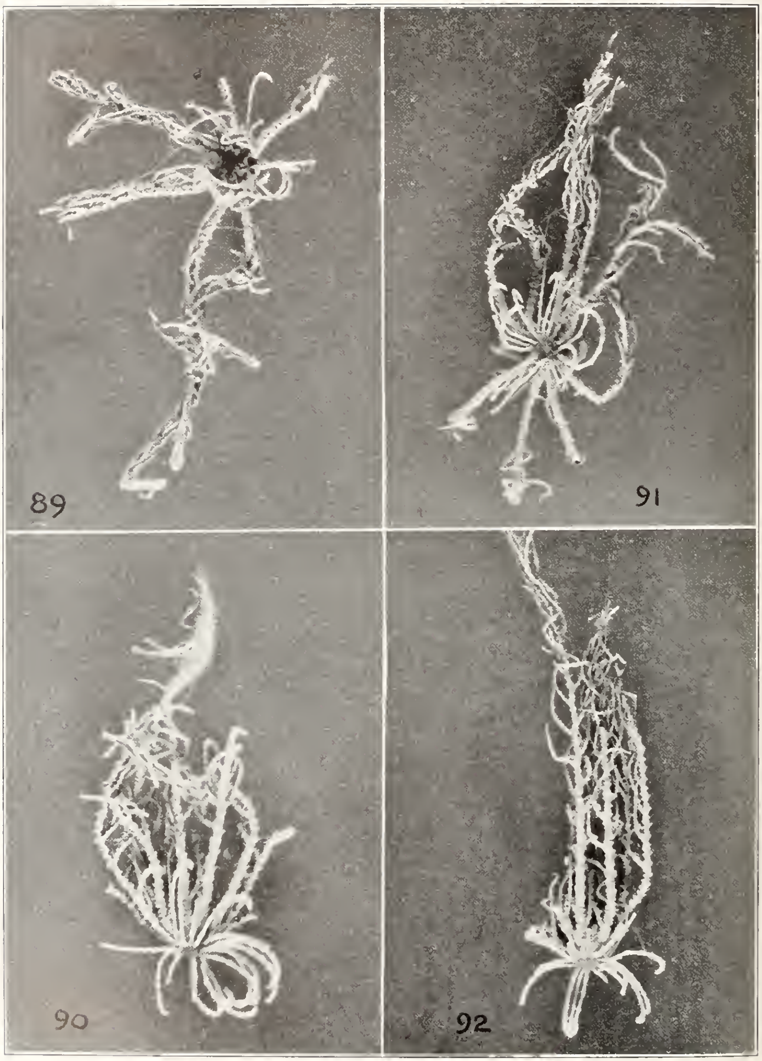

COMATILIA IRIDOMETRIFORMIS

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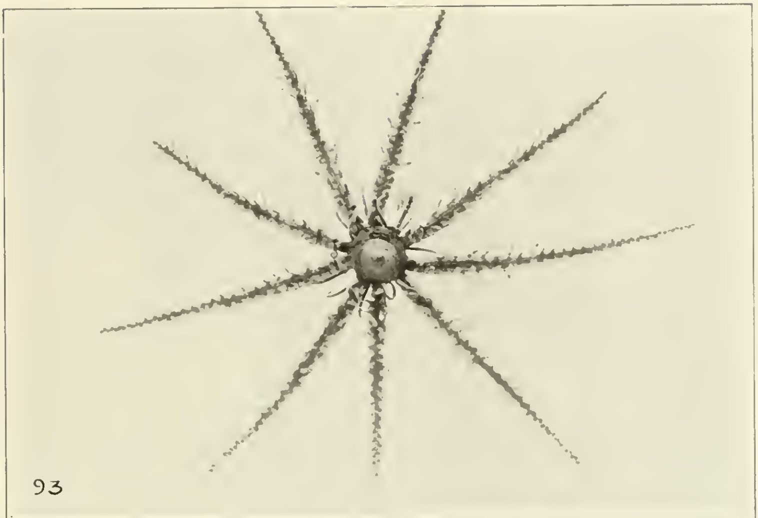
PLATE 30

FIGURES 89-92. *Comatilia iridometriformis*, cotypes from *Albatross* station 2671, ×3 (U.S.N.M., 14699).

PLATE 31

FIGURES 93, 94. *Comatulella brachiolata*, a specimen from the ?vicinity of Perth, Western Australia, in dorsal and ventral views (H. M.).



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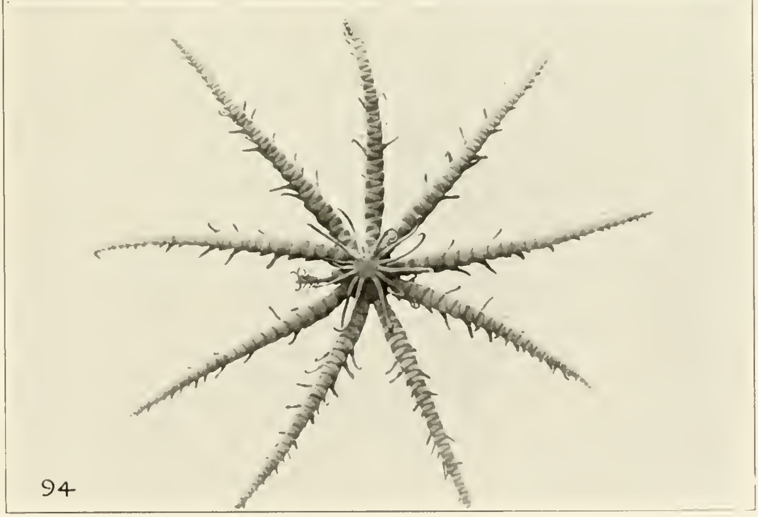

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COMATULELLA BRACHIOLATA

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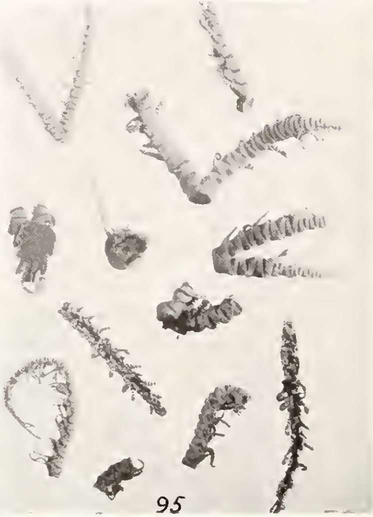

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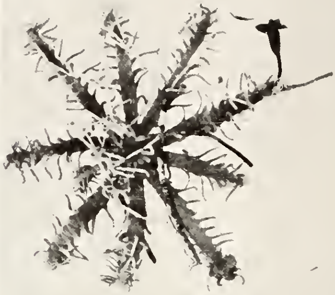

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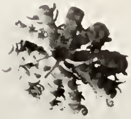

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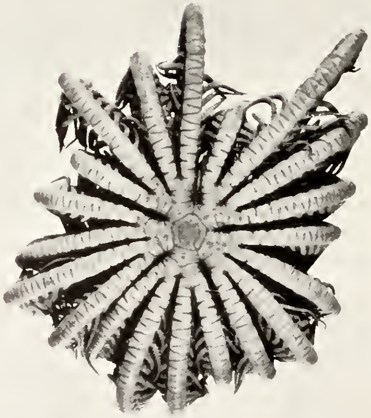

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COMATULELLA BRACHIOLATA AND COMATULA ROTALARIA

FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 32

FIGURE 95. *Comatulella brachiolata*, the cotypes of *Alecto rosea* (Berl. M.). For a diagrammatic reconstruction based on these fragments see vol. 1, pt. 1, fig. 77, p. 130.

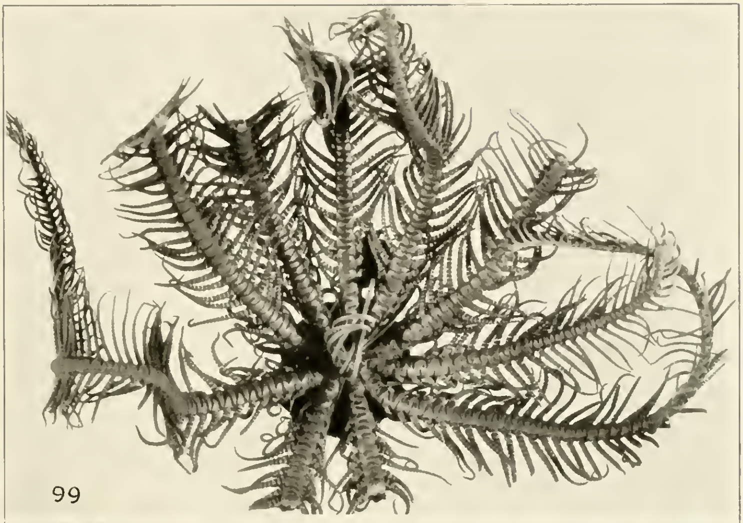
96, 97. *Comatulella brachiolata* from Koombana Bay, Western Australia (Berl. M., 5967).

98. *Comatula rotalaria*, a typical specimen from Albany Passage, Queensland (U.S.N.M., 34928).

PLATE 33

FIGURE 99. *Comatula solaris*, a typical specimen from Port Denison, Queensland (U.S.N.M., 17858).

100. *Comatula pectinata* from *Albatross* station 5142 (U.S.N.M., 34924).



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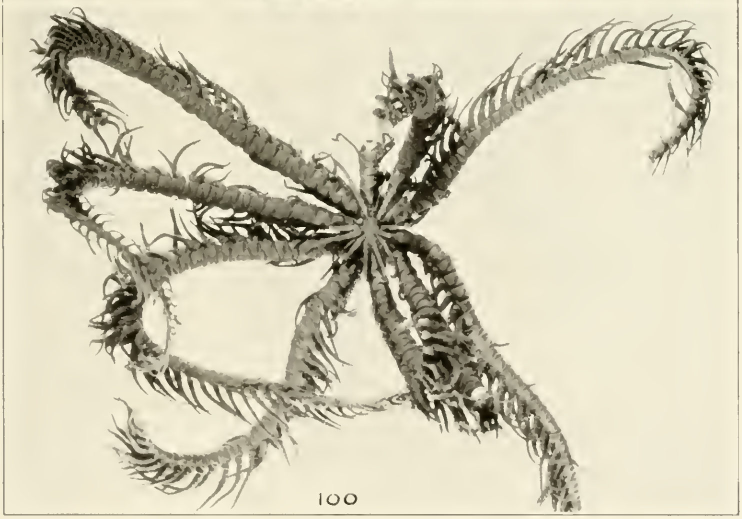

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COMATULA SOLARIS AND C. PECTINATA

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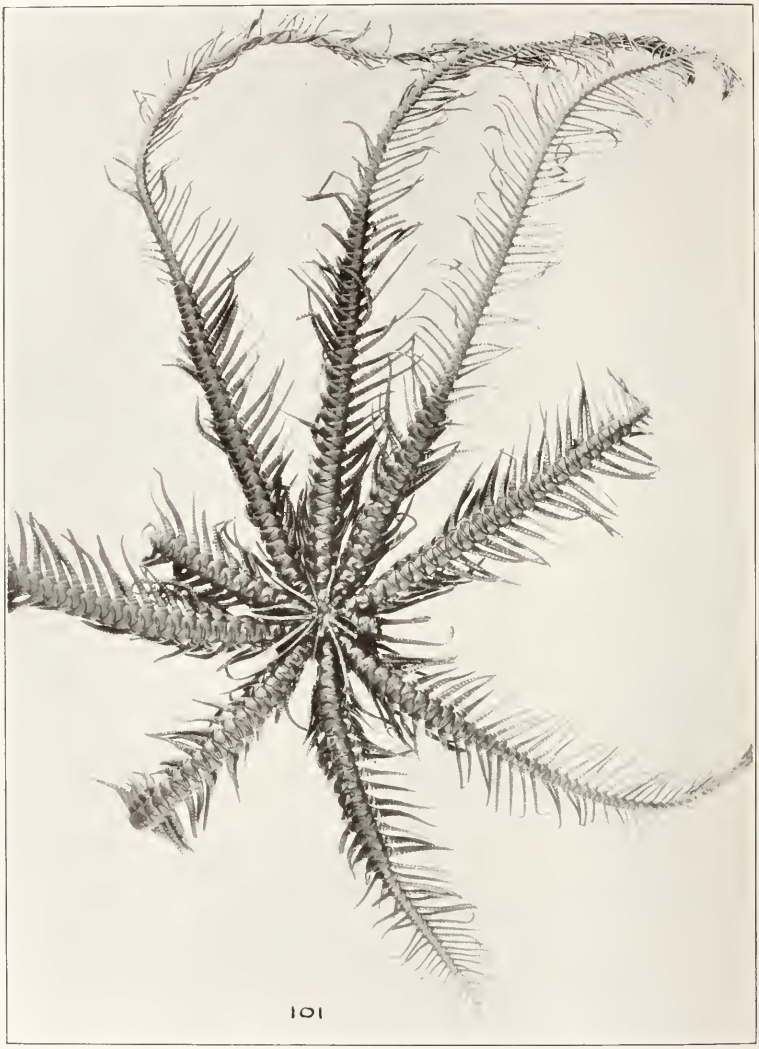


COMATULA PECTINATA

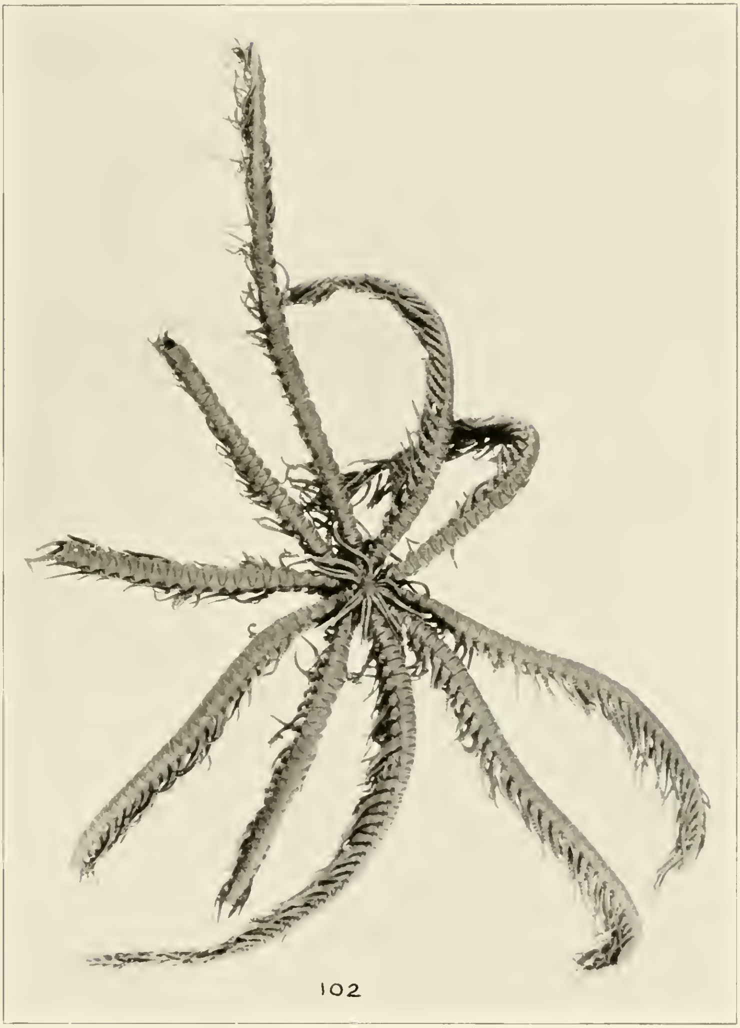
FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 34

FIGURE 101. *Comatula pectinata*, a very large specimen from the Danish expedition to the Kei Islands station 67.

PLATE 35

FIGURE 102. *Comatula pectinata*, a very large specimen from the Danish expedition to the Kei Islands station 111.



COMATULA PECTINATA

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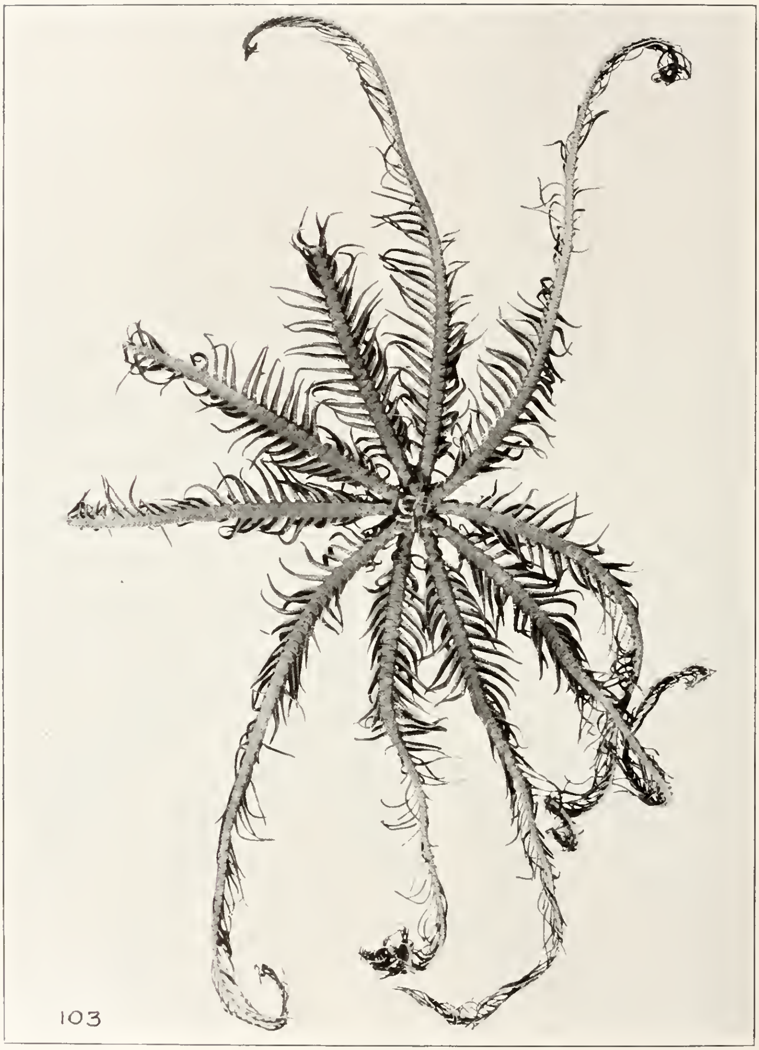


COMATULA PECTINATA

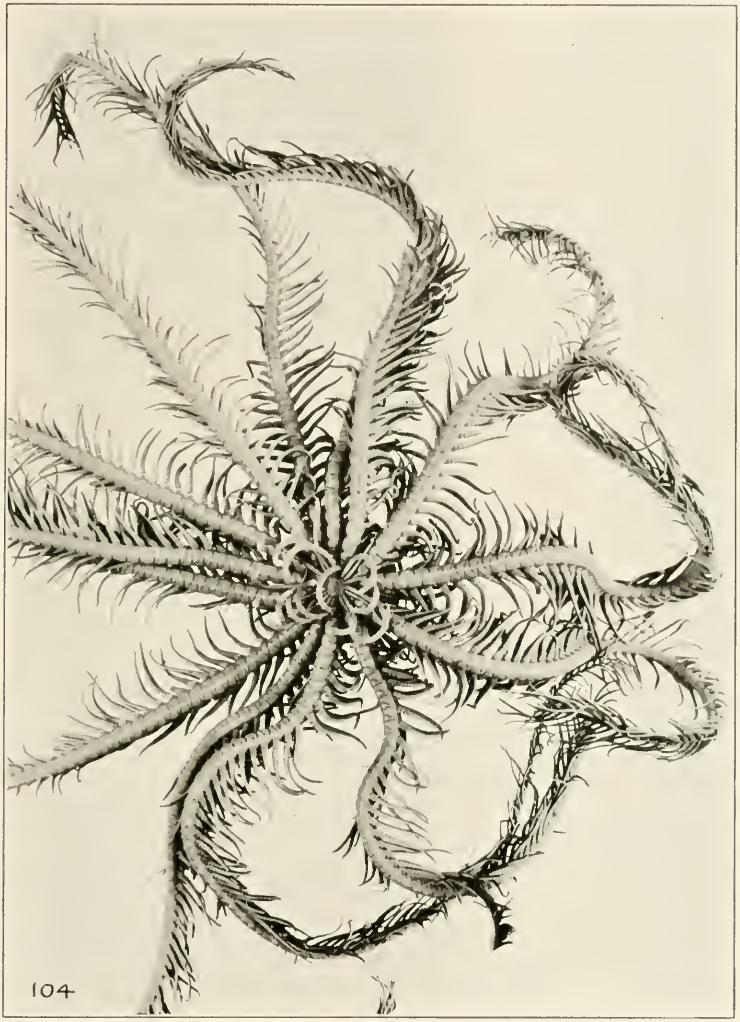
FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 36

FIGURE 103. *Comatula pectinata*, a very large slender armed specimen from the Danish expedition to the Kei Islands station 67.

PLATE 37

FIGURE 104. *Comatula pectinata*, a very large specimen with 14 arms from the Danish expedition to the Kei Islands station 67.



COMATULA PECTINATA

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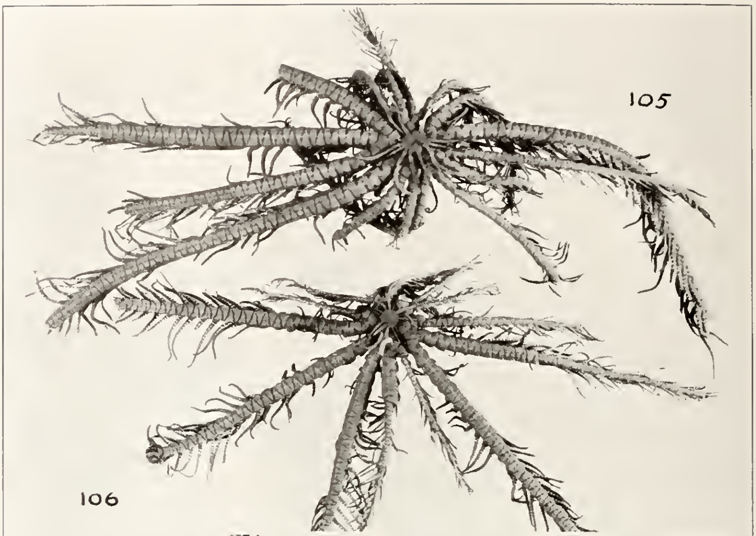

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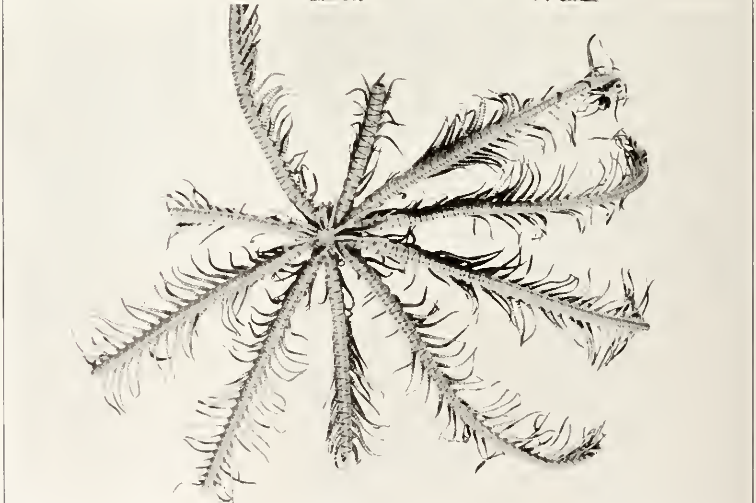

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COMATULA PECTINATA

FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 38

FIGURE 105. *Comatula pectinato*, a specimen with 16 arms from the Danish expedition to the Kei Islands station 67.

106. *Comatula pectinata*, a specimen with 17 arms from the Danish expedition to the Kei Islands station 67.

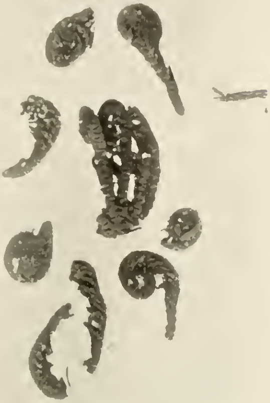
107. *Comatula pectinata*, a specimen with 11 arms from the Danish expedition to the Kei Islands station 85.

PLATE 39

FIGURE 108. *Comatula purpurea*, the type specimen from Australia (Berl. M. 1049). For a line drawing of this specimen see vol. 1, pt. 1, fig. 79, p. 132.

109. *Comatula purpurea*, a 4-rayed specimen from *Siboga* station 273 (Amsterdam Mus.).

110. *Comatula tenuicirra*, the type specimen from *Siboga* station 320, × 2 (Amsterdam Mus.).



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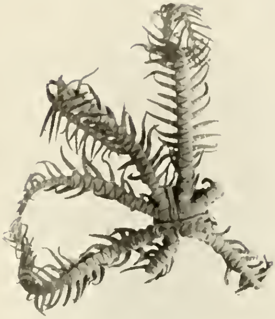

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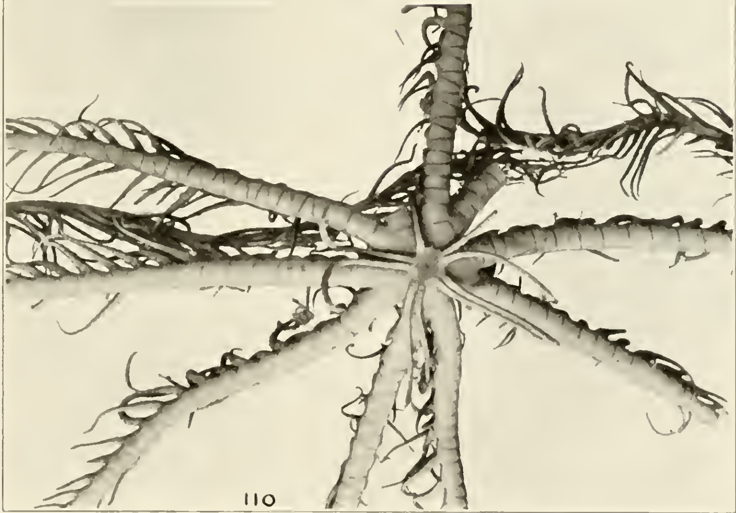

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COMATULA PURPUREA AND C. TENUICIRRA

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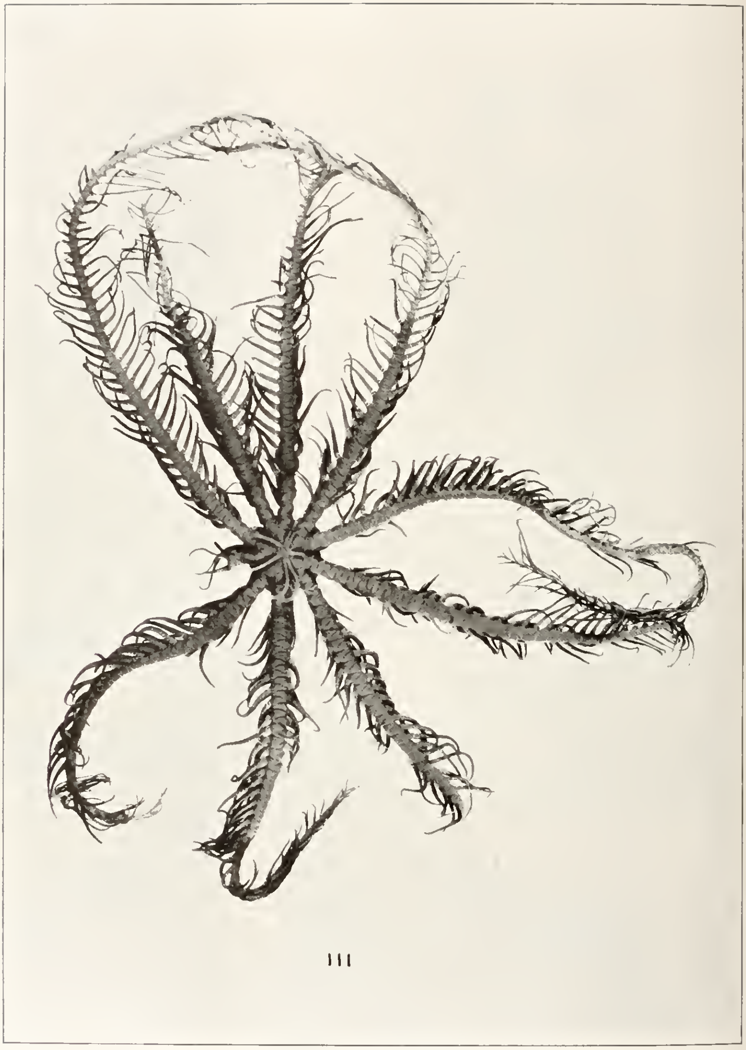


Comatula purpurea

For explanation of plate see page facing.

PLATE 40

FIGURE 111. *Comatula purpurea* from Freycinet Reach, Shark Bay, Western Australia (U.S.N.M. 31926).

PLATE 41

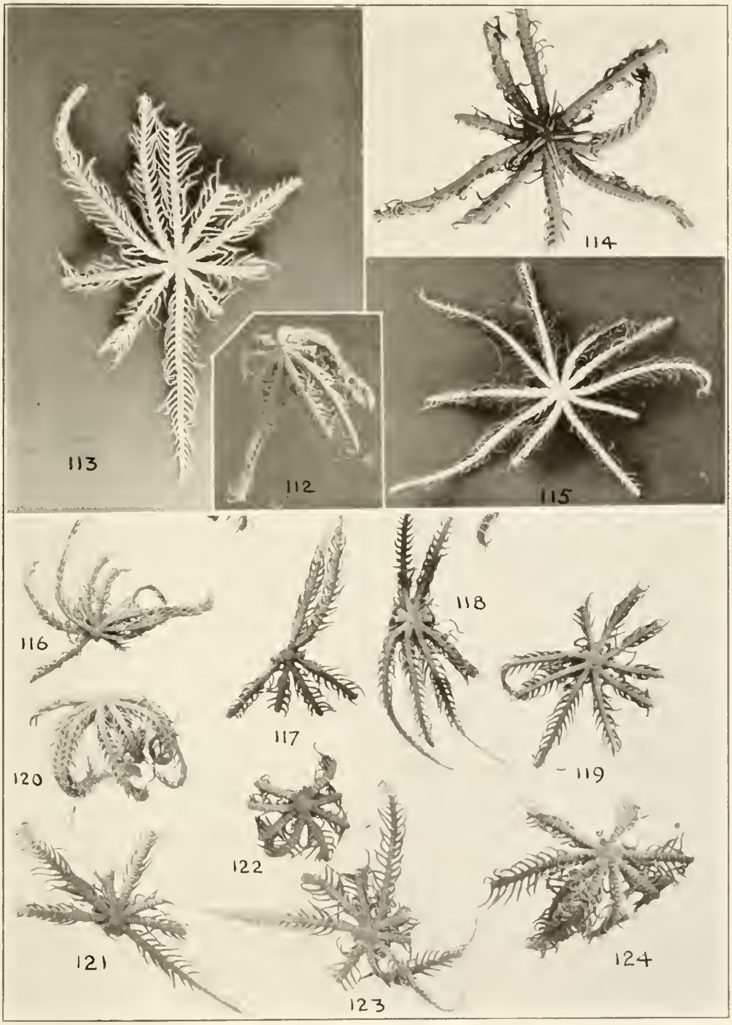
FIGURE 112. *Comatula micraster*, the type specimen collected by the *Investigator* in the Andaman Islands in 110 meters (I. M.).

113. *Comatula micraster* from the Andaman Islands in 110 meters (U.S.N.M., 34935).

114. *Comatula purpurea* from the Danish expedition to the Kei Islands station 67.

115. *Comatula micraster* from the Andaman Islands in 110 meters (U.S.N.M., 34935).

116–124. *Comatula micraster* from the Andaman Islands in 110 meters (I. M.).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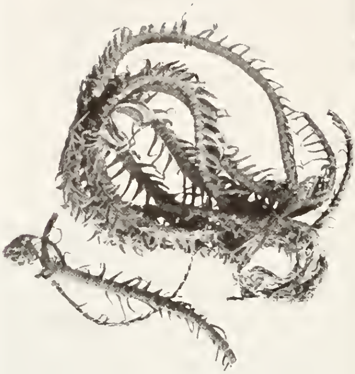
Comatula micraster and C. purpurea

For explanation of plate see page facing.



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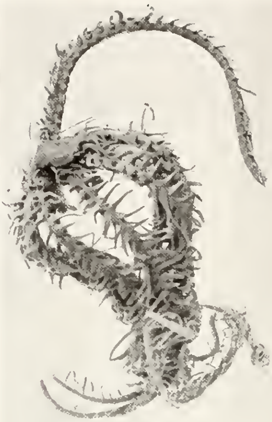

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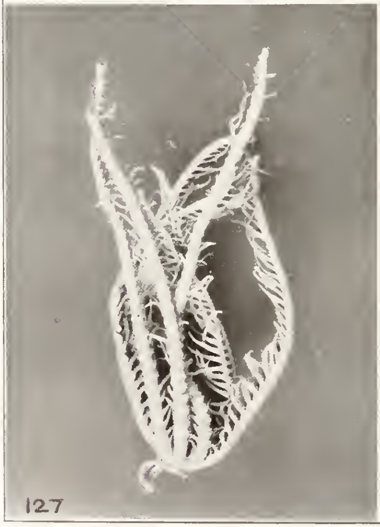

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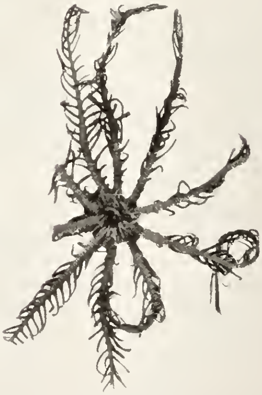


128

Comactinia echinoptera

For explanation of plate see page facing.

PLATE 42

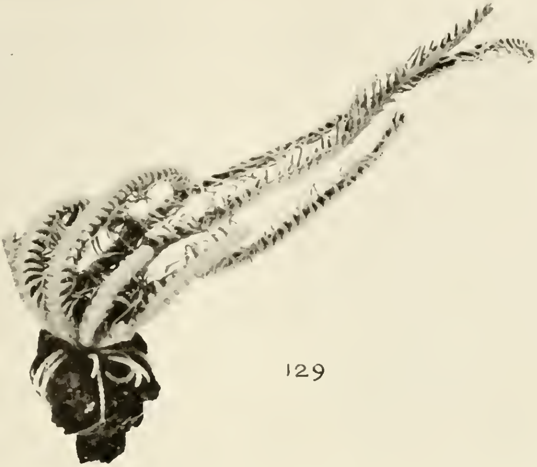
FIGURES 125, 126. *Comactinia echinoptera*, the type specimen from an unknown locality (Berl. M.).

127. *Comactinia echinoptera* from *Albatross* stations 2319-2350 (U.S.N.M., 34889).

128. *Comactinia echinoptera* from Blackfish Banks, off Charleston, S. C., in 22 meters (U.S.N.M., 3803).

PLATE 43

FIGURE 129. *Comactinia echinoptera* from *Albatross* stations 2319 2350 (U.S.N.M., 34889).
130. *Comactinia echinoptera* from *Albatross* station 2142, ×2 (U.S.N.M., 34824).



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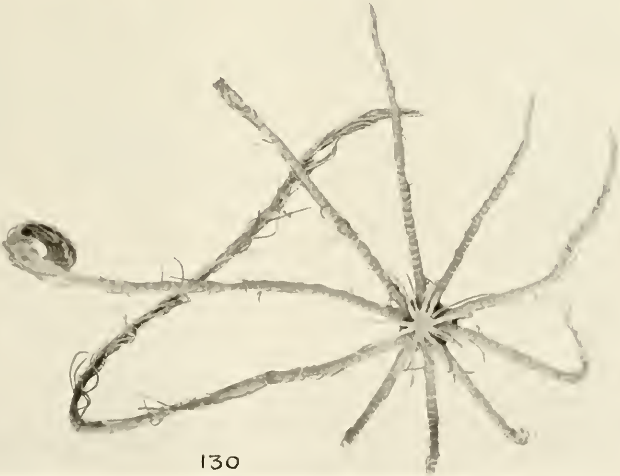

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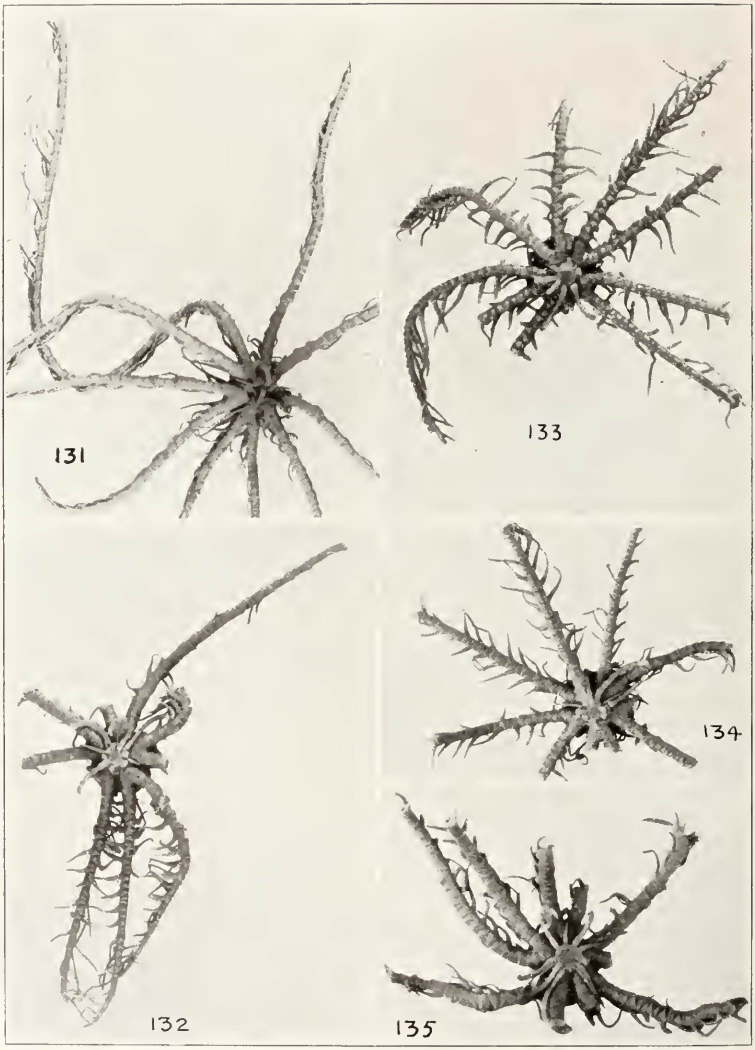
Comactinia echinoptera

For explanation of plate see page facing.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COMACTINIA ECHINOPTERA

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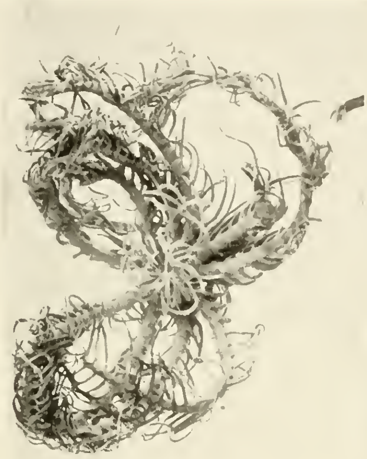
PLATE 44

FIGURE 131. *Comactinia echinoptera* from *Albatross* station 2142, ×2 (U.S.N.M., 34824).
132–135. *Comactinia echinoptera* collected by the *Bibb* off French Reef (U.S.N.M., 34624).

Plate 45

Figures 136, 137. *Comatulides decameros*, the type specimen from lat. 32° 22′ N., long. 128° 42′ E. in 311 meters (C. M.).

138, 139. *Comatulides australis*, the type specimen from *Siboga* station 297 (Amsterdam Mus.).



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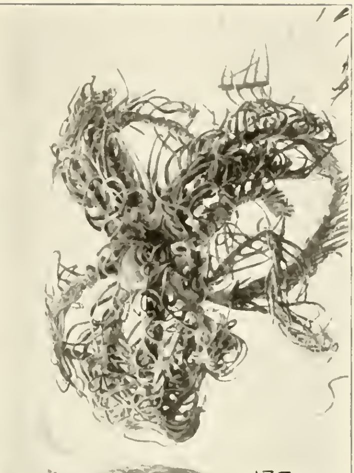

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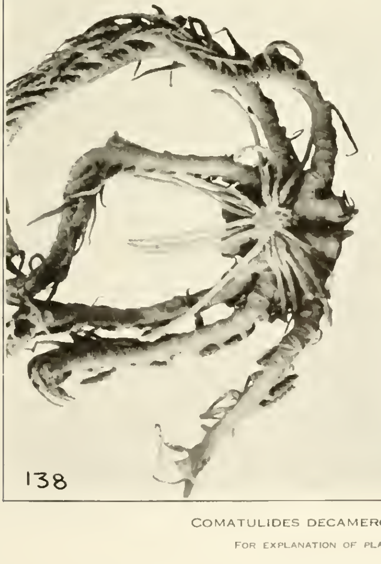

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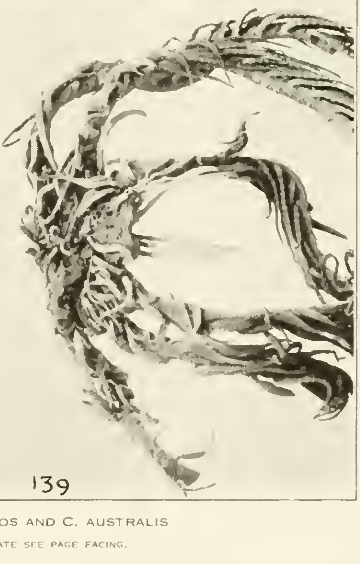

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Comatulides decameros and C. australis

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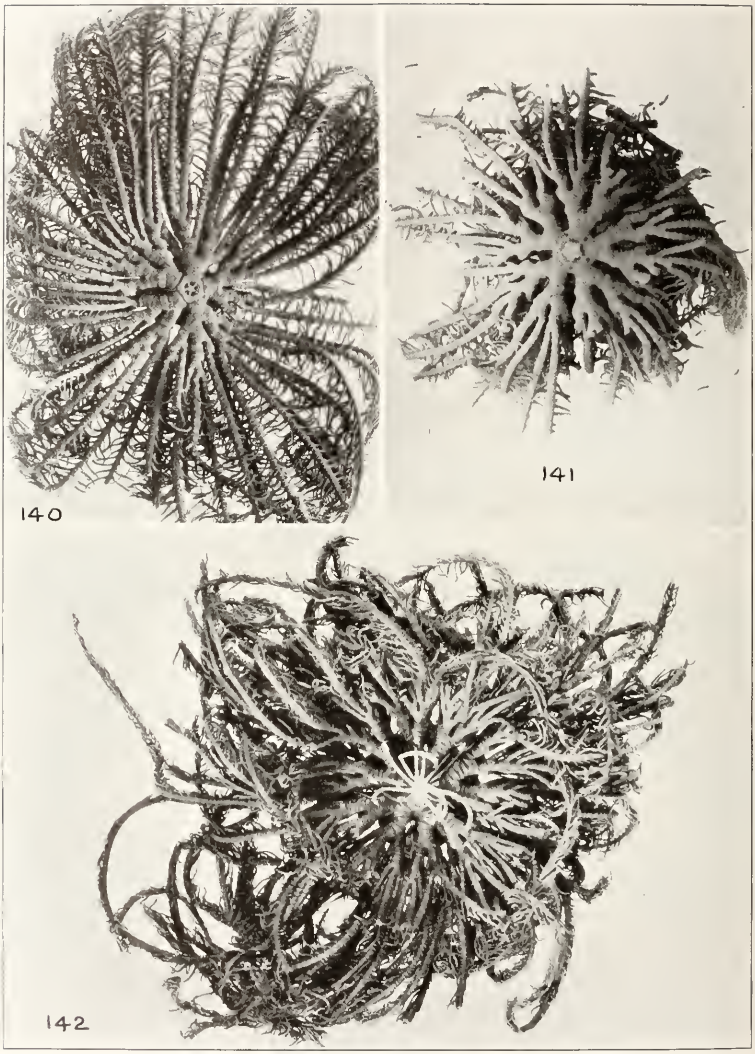

COMASTER MULTIFIDA (UPPER) AND C. MULTIBRACHIATA (LOWER)

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PLATE 46

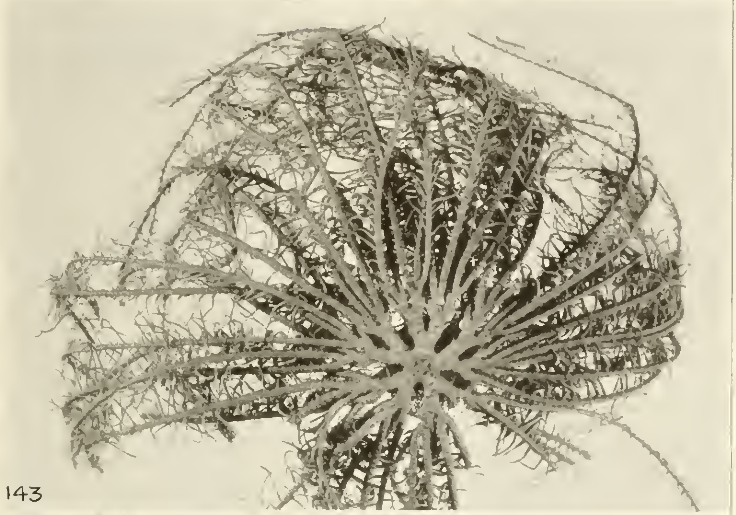
FIGURE 140. *Comaster multifida*, the specimen from Fiji labeled by Lütken *Antedon stellatus* (C. M.).

141. *Comaster multifida* collected by the *Gazelle* north of Port Walcott, Western Australia, in 91 meters (Berl. M.).

142. *Comaster multibrachiata* from the Andaman Islands (U.S.N.M., 35967).

Plate 47

Figures 143, 144. *Comaster gracilis* from Gat van Soutre, Banda, in 25 meters.



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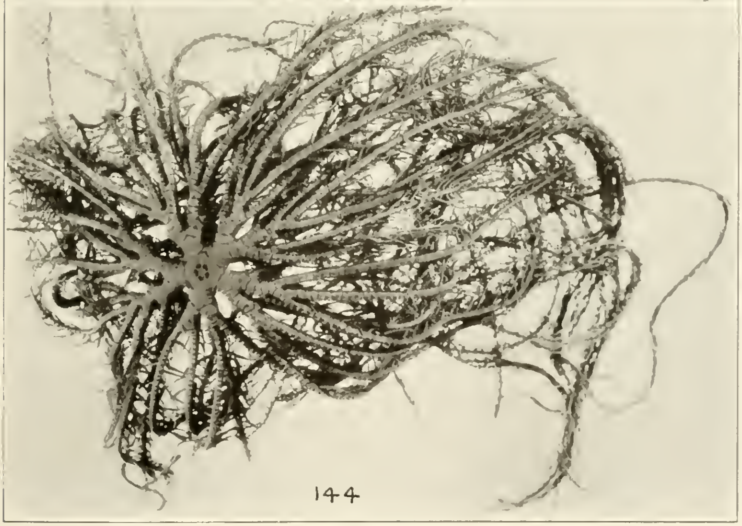

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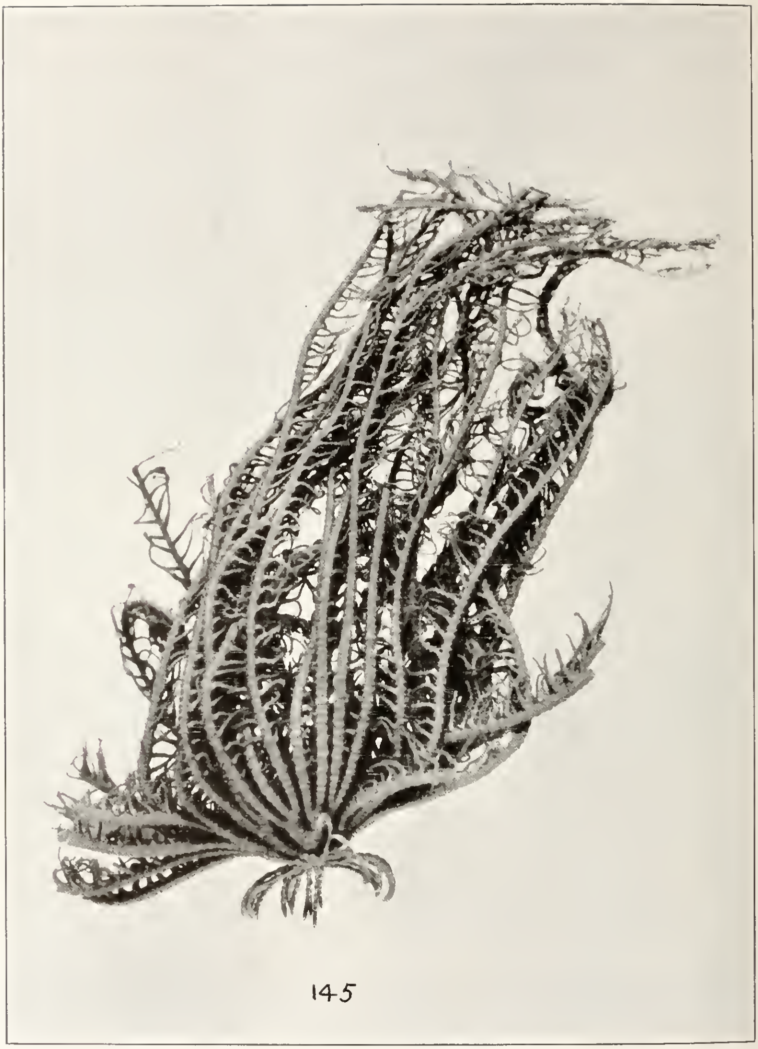
Comaster gracilis

For explanation of plate see page facing.



COMASTER FRUTICOSUS

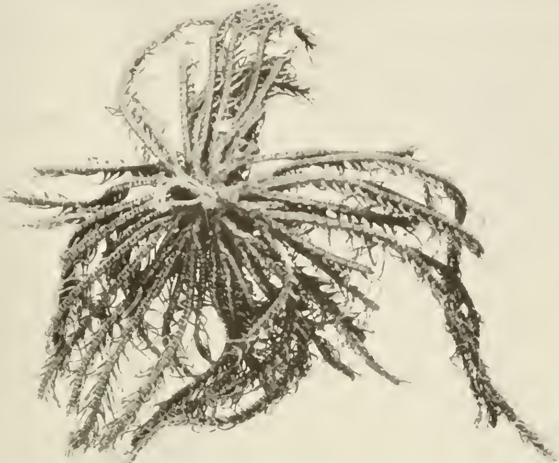
FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 48

FIGURE 145. *Comaster fruticosus*, the type specimen from *Albatross* station 5356, × 2 (U.S.N.M., 27486).

Plate 49

Figures 146, 147. *Comaster fruticosus* from *Albatross* station 5179 (U.S.N.M., 34959).



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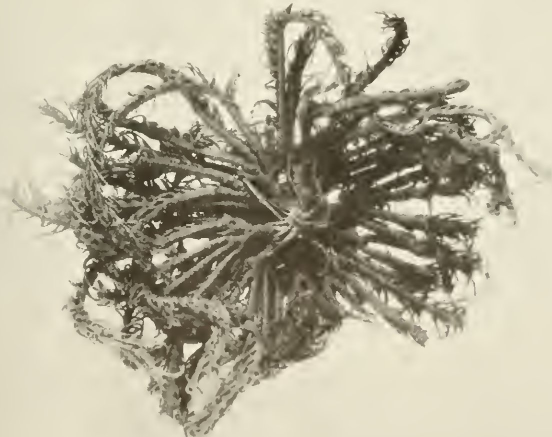

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COMASTER FRUTICOSUS

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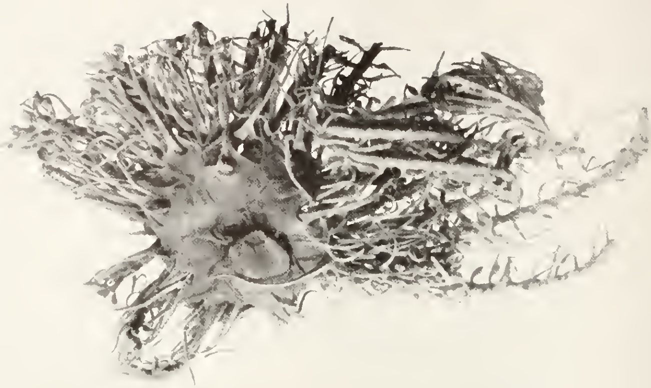

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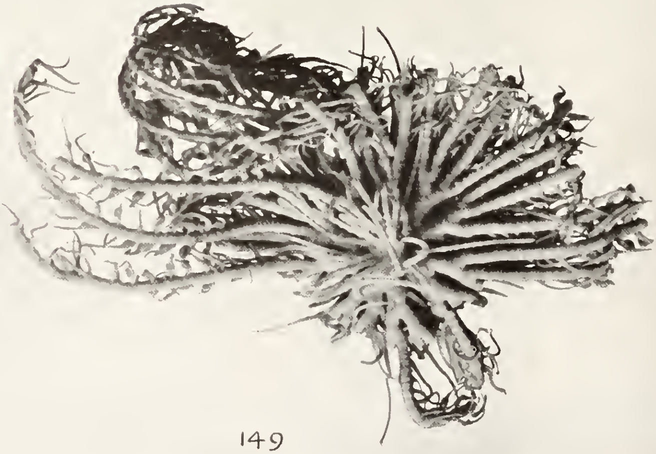


149

COMASTER PULCHER

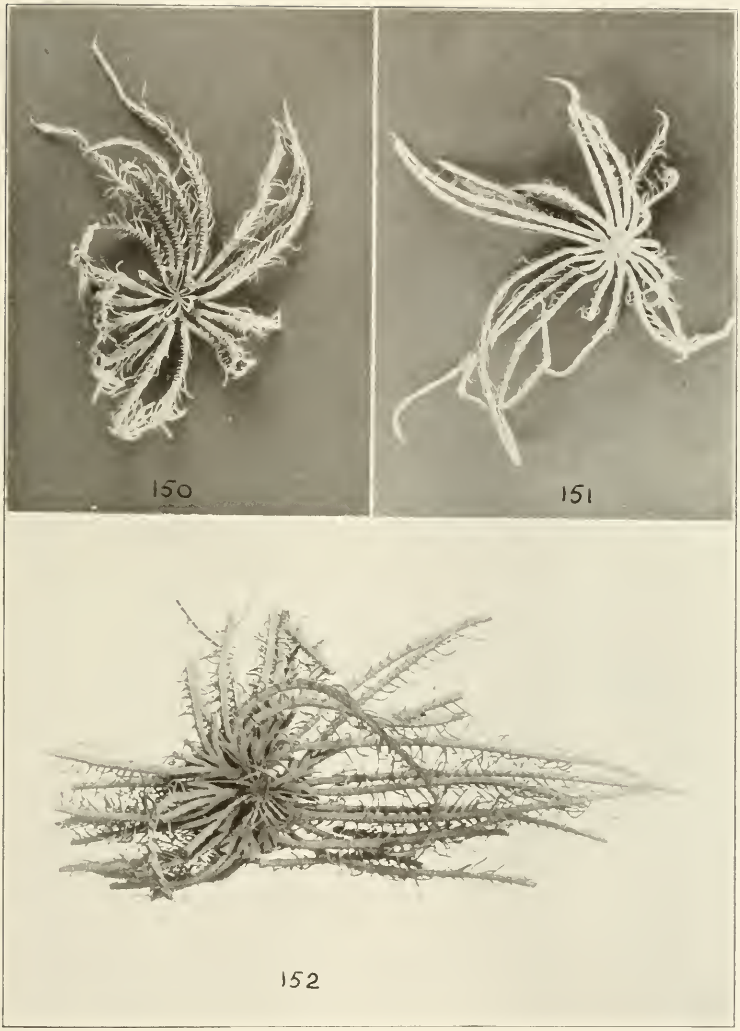
FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 50

FIGURES 148, 149. *Comaster pulcher*, the type specimen from *Siboga* station 257, × 2 (Amsterdam Mus.).

PLATE 51

FIGURES 150, 151. *Comaster tenella* from Singapore (U.S.N.M., E. 1087).
152. *Comaster sibogae*, the type specimen from *Siboga* station 318 (Amsterdam Mus.).



COMASTER TENELLA AND C. SIBOGAE

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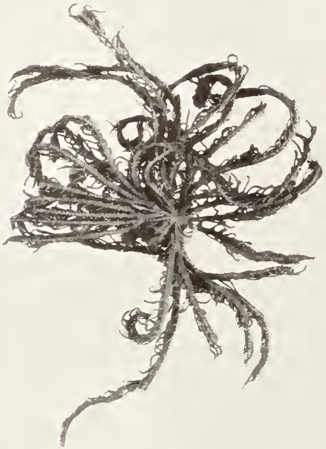
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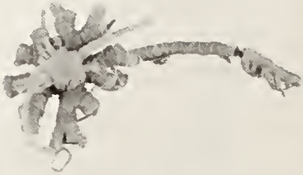
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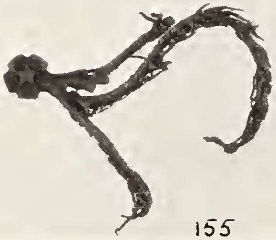
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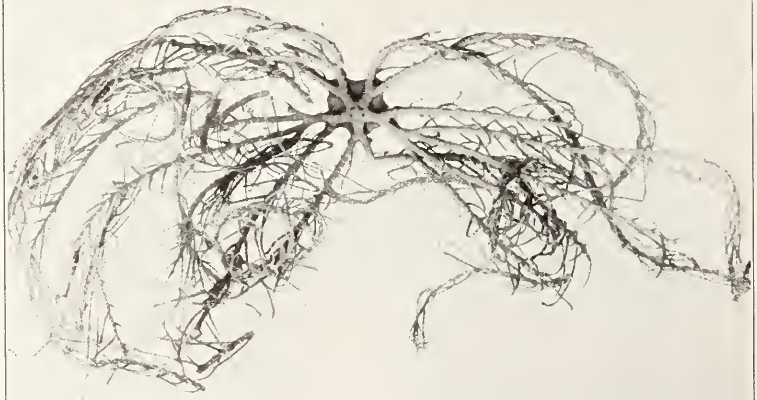

156

COMASTER DISTINCTA, C. SERRATA, AND C. MINIMA

FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 52

FIGURE 153. *Comaster distincta* from *Albatross* station 5137 (U.S.N.M., 35048).

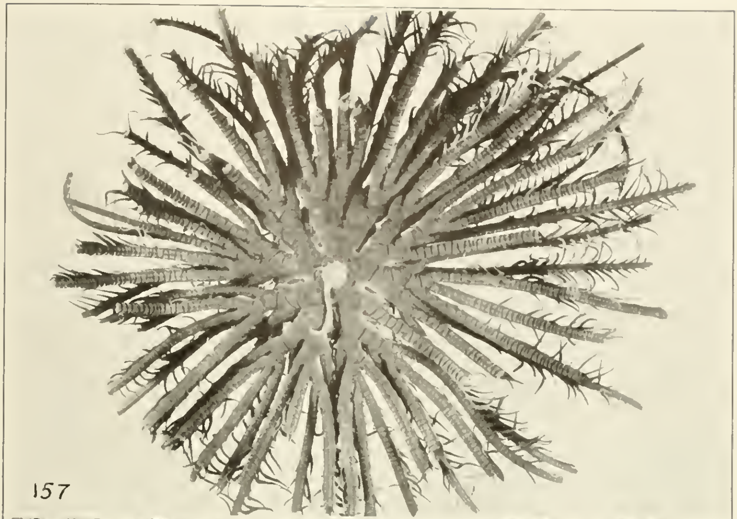
154. *Comaster serrata*, the type from *Albatross* station 4895, ×2 (U.S.N.M., 22657).

155. *Comaster minima*, the type specimen from *Albatross* station 5108, ×2 (U.S.N.M., 25469).

156. *Comaster minima* from *Siboga* station 302, ×2 (Amsterdam Mus.).

PLATE 53

FIGURE 157. *Comanthina belli* from Torres Strait (U.S.N.M., 36166).
158. *Comanthina schlegelii* from *Albatross* station 5145 (U.S.N.M., 35125).



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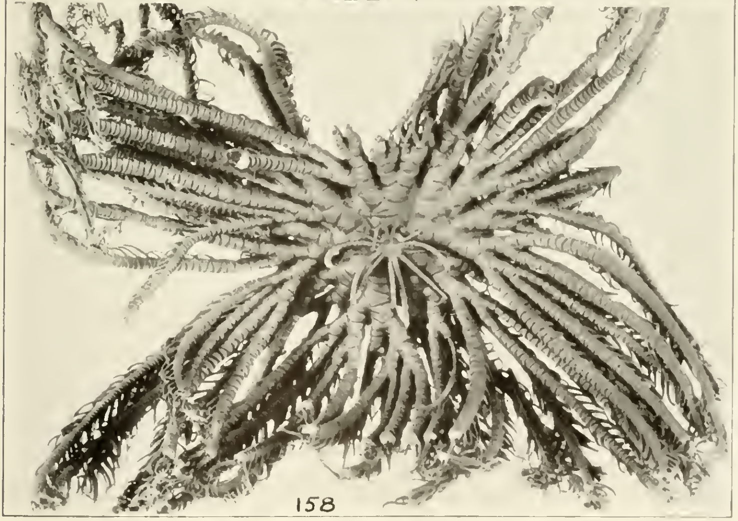

158

COMANTHINA BELLI AND C. SCHLEGELII

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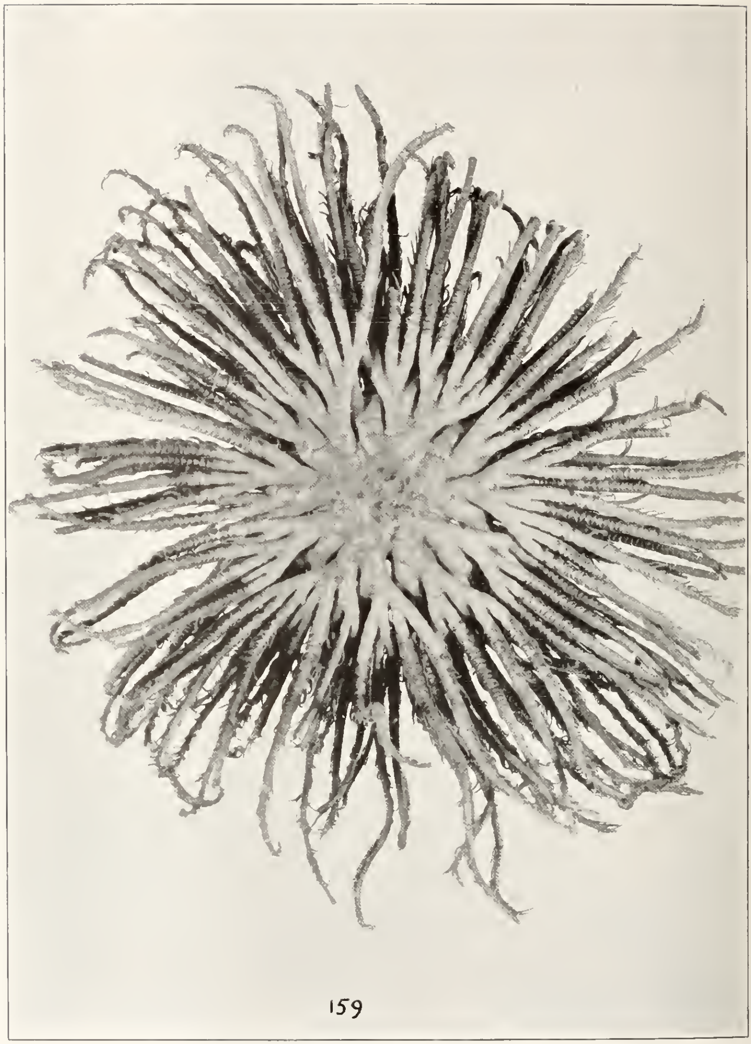


COMANTHINA SCHLEGELII

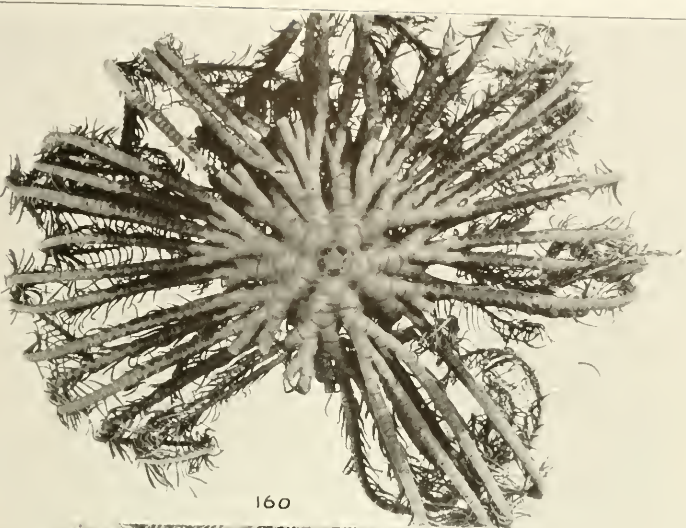
FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 54

FIGURE 159. *Comanthina schlegelii* from *Albatross* station 5253 (U.S.N.M., 35114).

Plate 55

Figure 160. *Comanthina schlegelii* from the Danish expedition to the Kei Islands station 30.
161. *Comanthina schlegelii* from the Danish expedition to the Kei Islands station 67.



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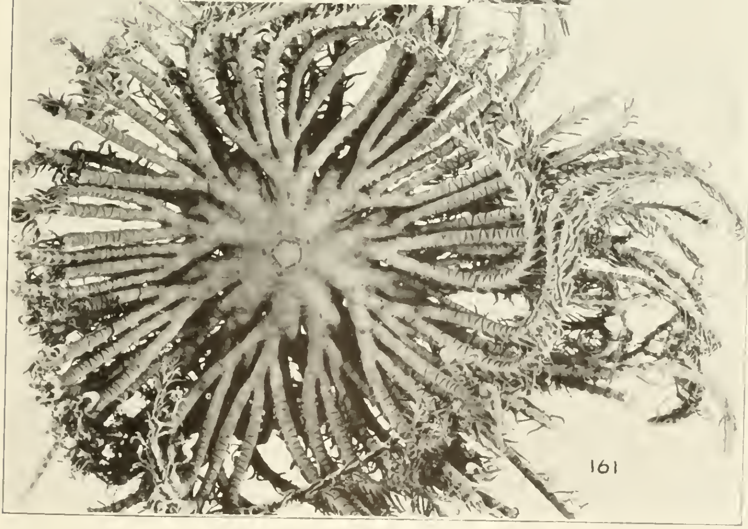

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COMANTHINA SCHLEGELII

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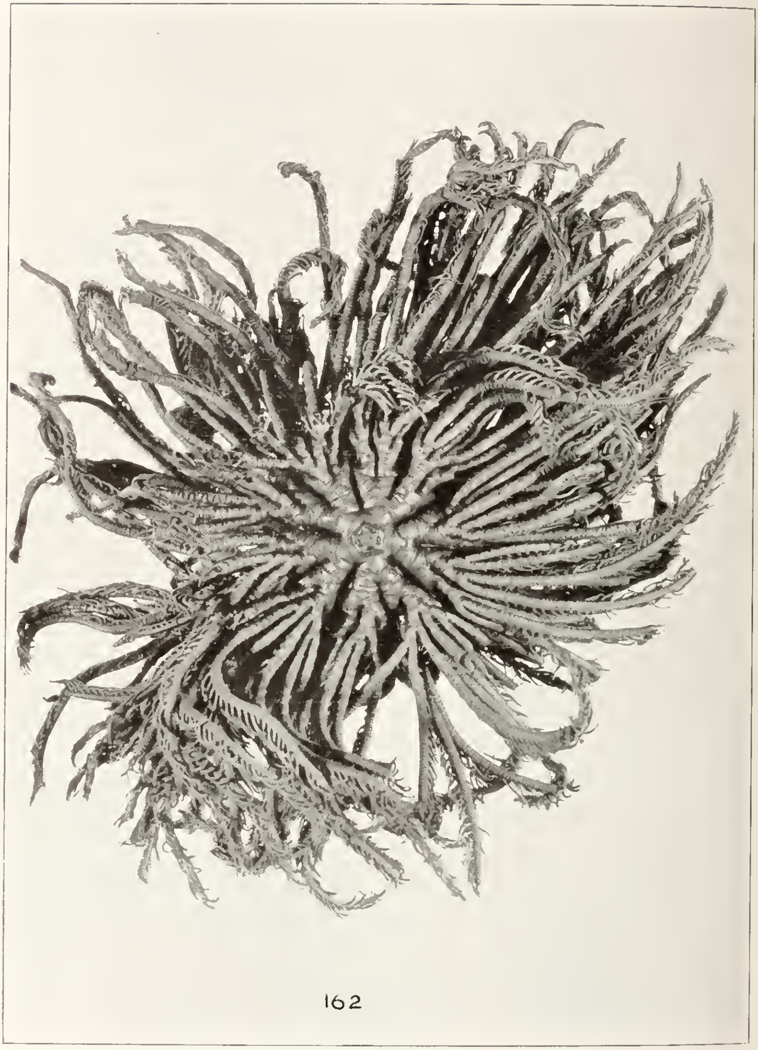


Comantheria polycnemis

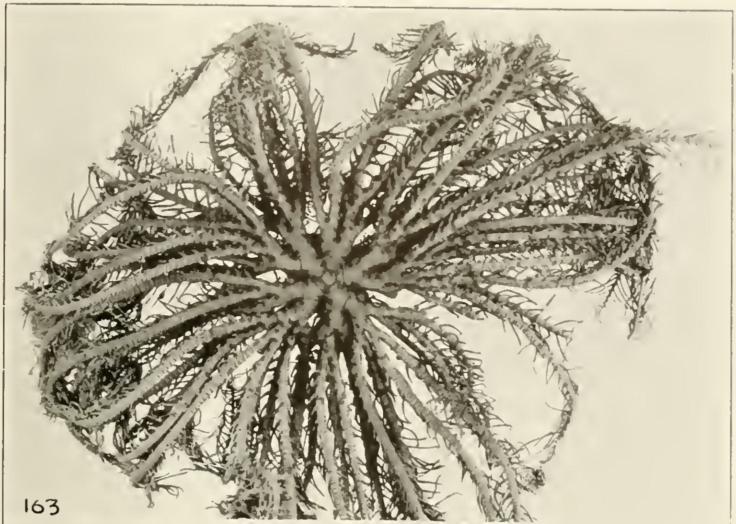
For explanation of plate see page facing.

PLATE 56

FIGURE 162. *Comantheria polycnemis*, the type specimen from *Albatross* station 5249 (U.S.N.M., 25467).

PLATE 57

FIGURE 163. *Comantheria briareus* from the Danish expedition to the Kei Islands station 30.
164. *Comantheria briareus* collected by the Danish expedition to the Kei Islands off Neira, Banda, in about 20 meters.



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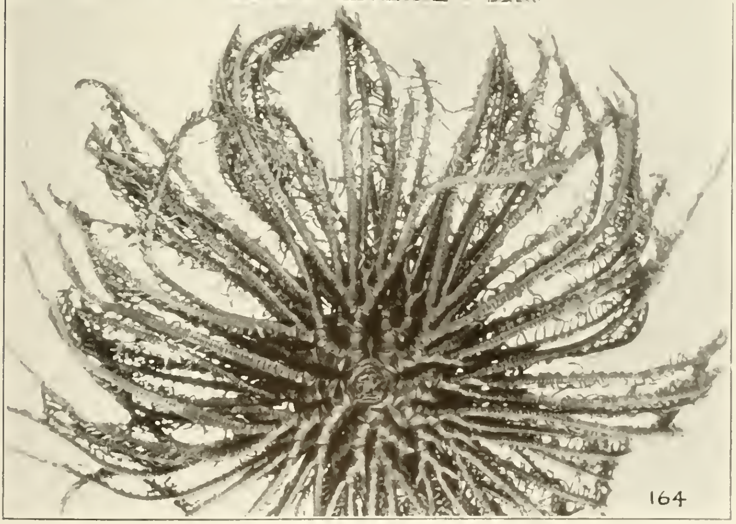

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COMANTHERIA BRIAREUS

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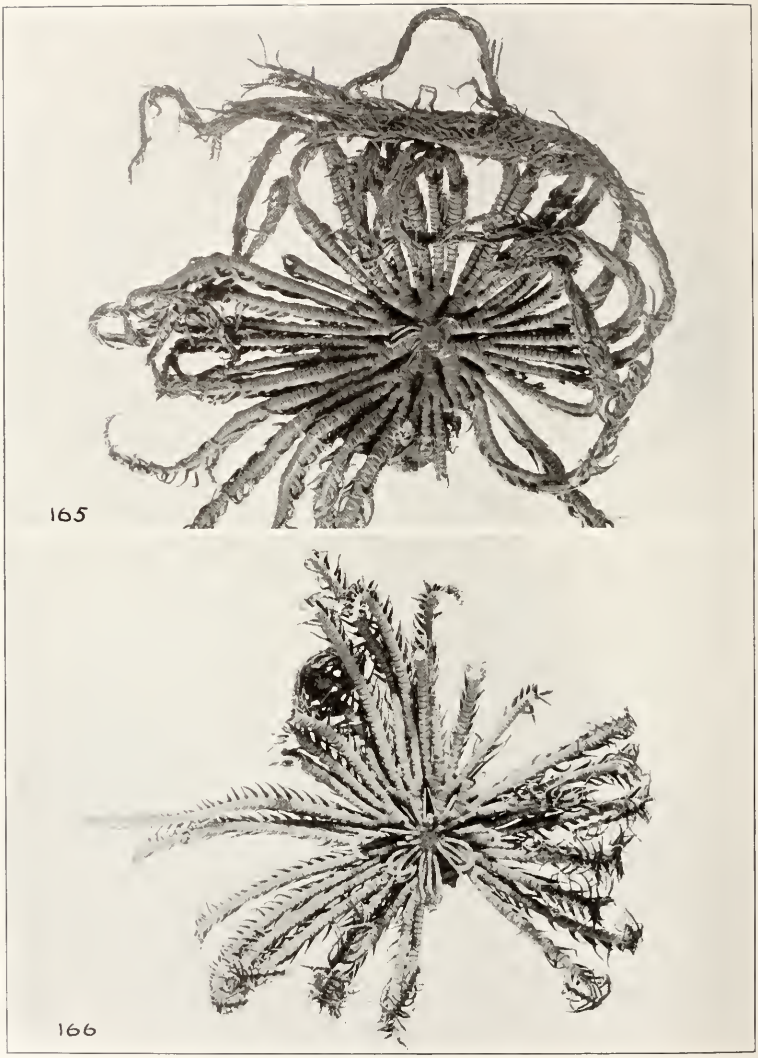

COMANTHERIA ROTULA AND C. WEBERI

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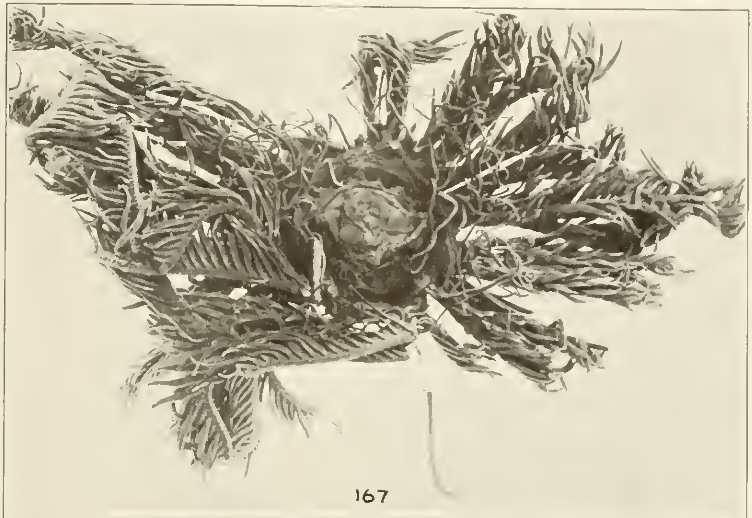
Plate 58

Figure 165. *Comantheria rotula*, the type specimen from *Siboga* station 273 (Amsterdam Mus.)

166. *Comantheria weberi*, the type specimen from *Siboga* station 49*a* (Amsterdam Mus.)

Plate 59

Figures 167, 168. *Comantheria grandicalyx*, the type specimen from Canton, China (H. M.).



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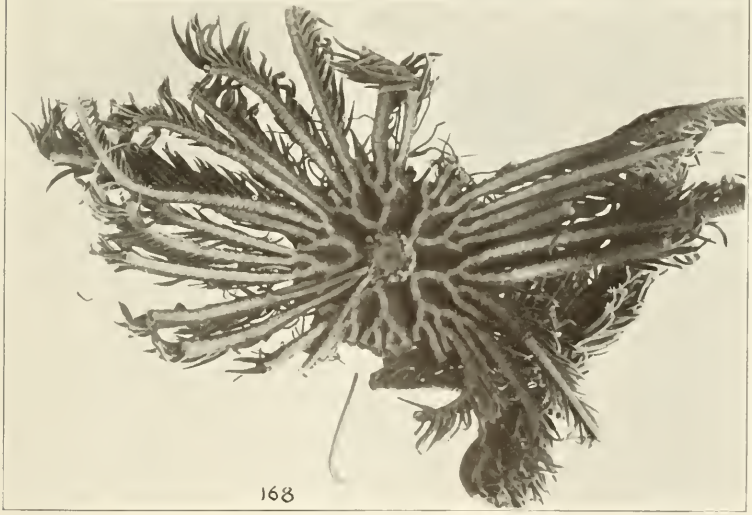

168

Comantheria grandicalyx

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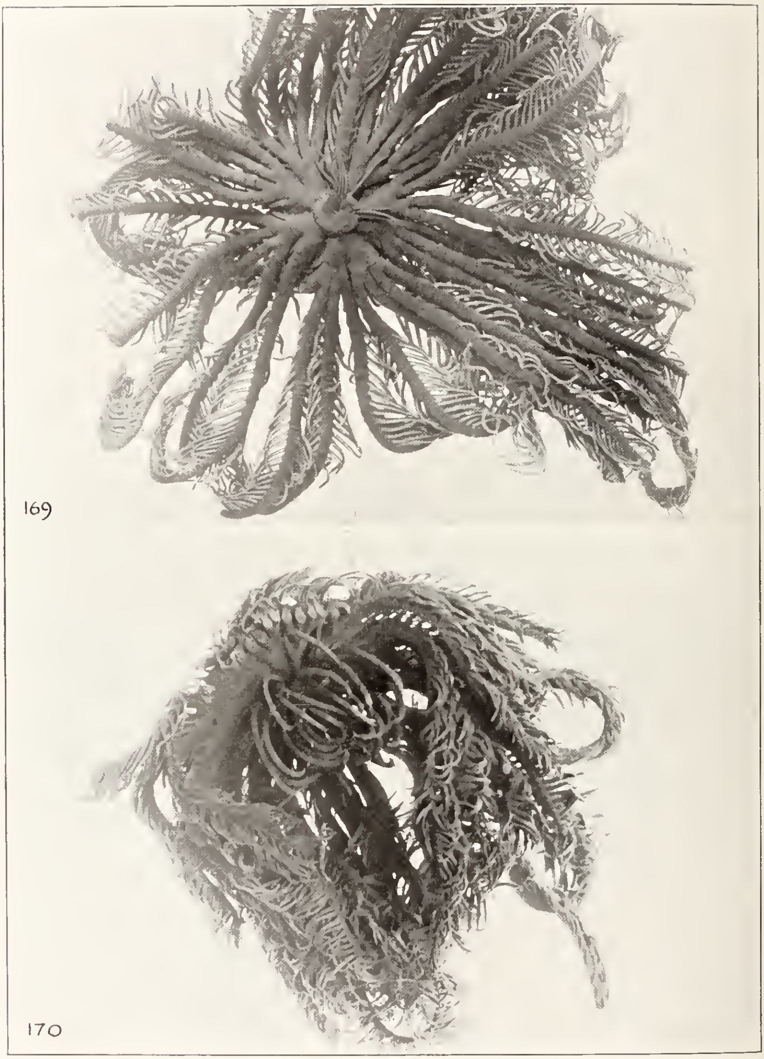


COMANTHERIA INTERMEDIA AND C. GRANDICALYX

FOR EXPLANATION OF PLATE SEE PAGE FACING

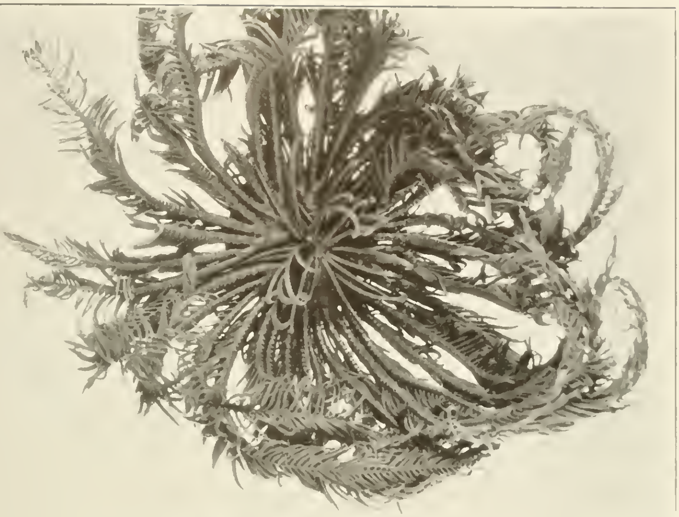
Plate 60

Figure 169. *Comantheria intermedia*, the type specimen from Sagami Bay, Japan, between Ito and Hatsushima, in about 150 meters (Munich Mus.).

170. *Comantheria grandicalyx* from Fuchow, China (H. M.).

PLATE 61

FIGURE 171. *Comantheria intermedia* from lat. 24° 06′ N., long. 118° 25′ E., in 36 meters (C. M.).
172. *Comantheria intermedia* from Sagami Bay, Japan, between Ito and Hatsushima (U.S.N.M., 35777).



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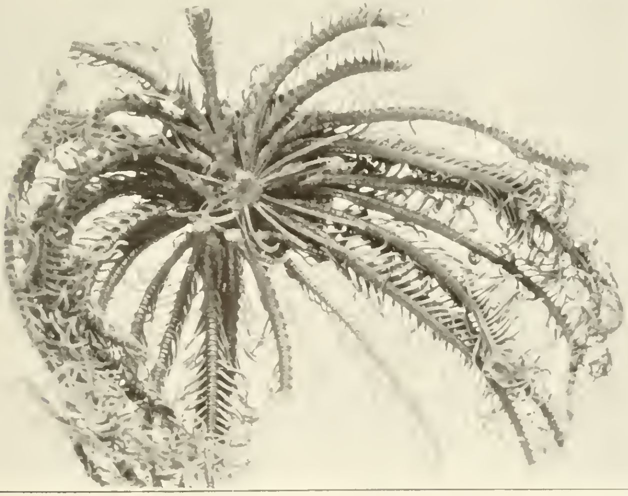
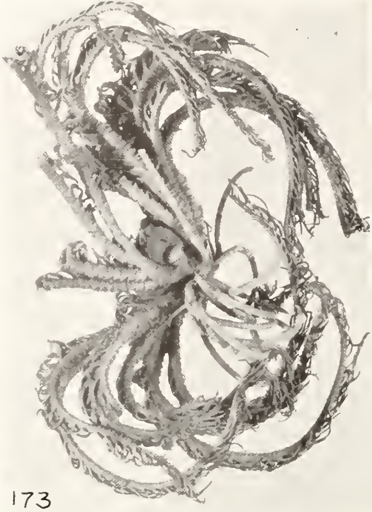


172

Comantheria intermedia

For explanation of plate see page facing



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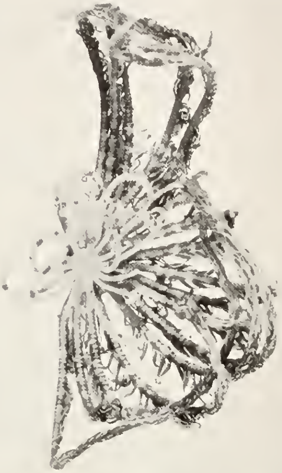

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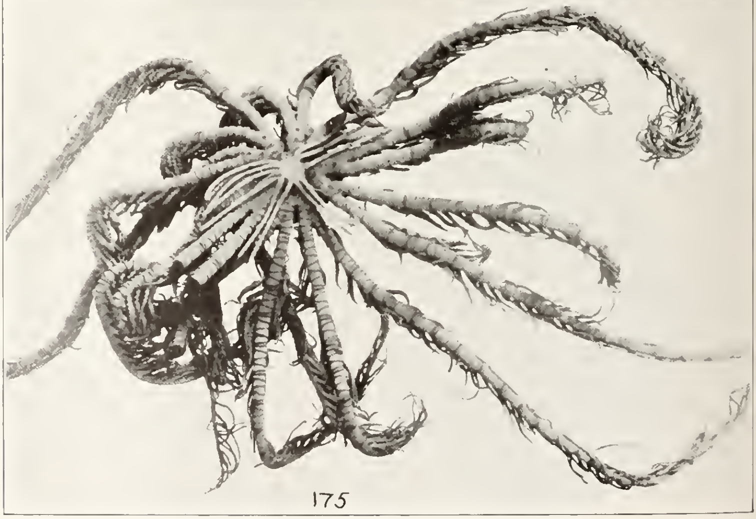


175

COMANTHERIA IMBRICATA AND C. DELICATA

FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 62

FIGURE 173. *Comantheria imbricata*, the type specimen from Sagami Bay, Japan (U.S.N.M., 22697).

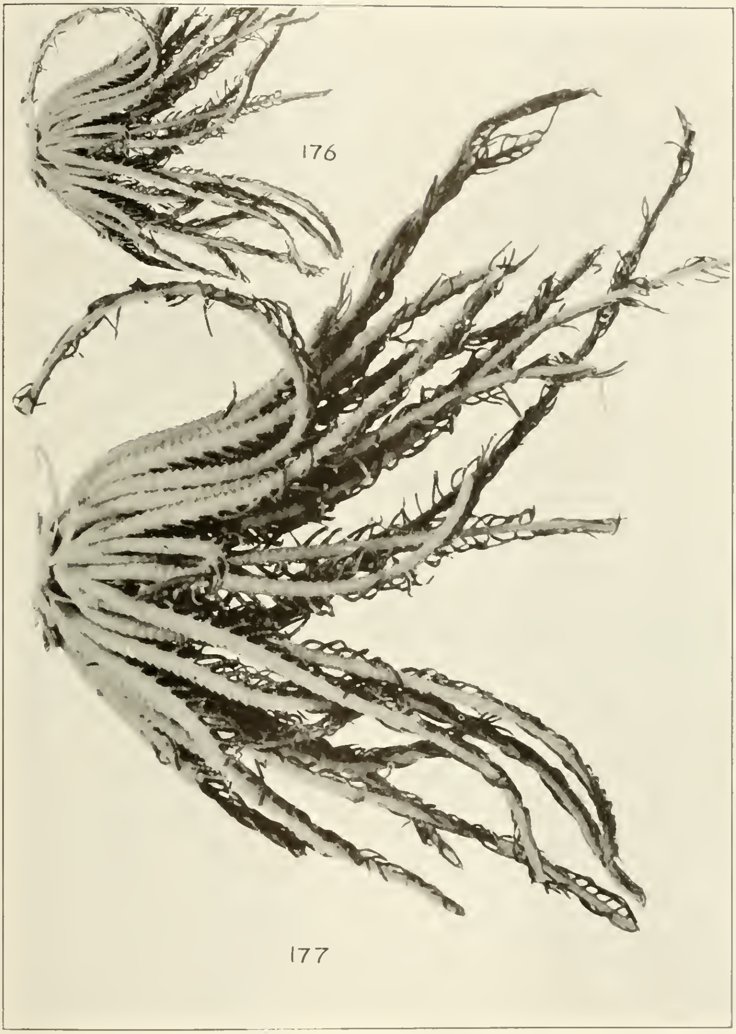
174. *Comantheria delicata*, the type specimen from *Albatross* station 5153 (U.S.N.M., 25463).

175. *Comantheria delicata* from *Siboga* station 282, ×2 (Amsterdam Mus.).

PLATE 63

FIGURE 176. *Comantheria taviana,* the type specimen from *Albatross* station **5153** (U.S.N.M., 35243).

177. *Comantheria taviana,* the type specimen, ×2.



COMANTHERIA TAVIANA

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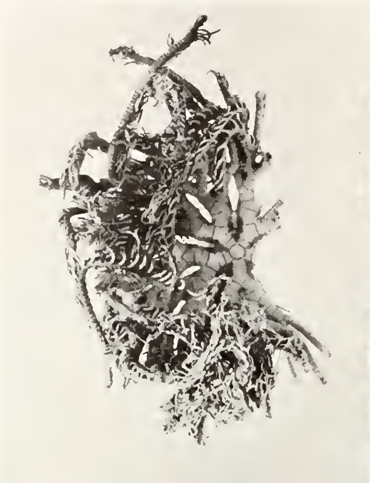

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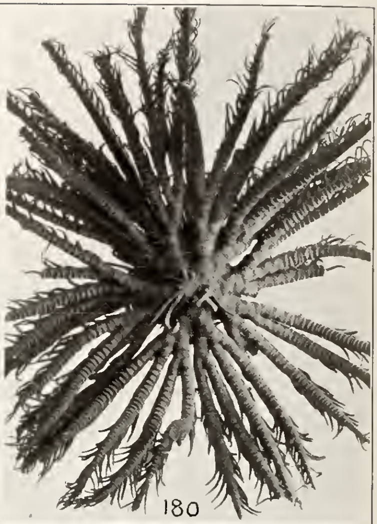

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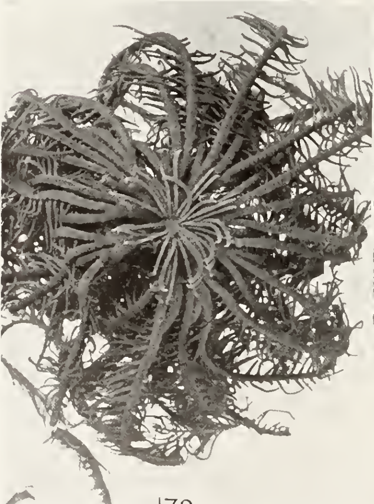

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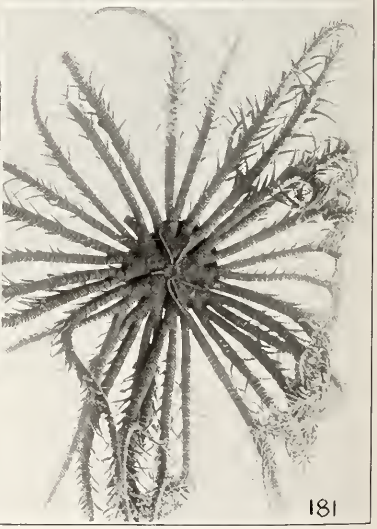


181

Comantheria briareus, Comanthina schlegelii, Comaster schönovi, and Comanthus timorensis

For explanation of plate see page facing

PLATE 64

FIGURE 178. *Comantheria briareus* collected by the *Gazelle* north of Port Walcott, Western Australia, in 91 meters (Berl. M., 3430).

179. *Comaster schonovi* from Singapore (C. M.).

180. *Comanthina schlegelii* from Mortlock Island, Carolines (H. M.).

181. *Comanthus timorensis*, a specimen from Tonga labeled by Lutken *Actinometra intricata* (C. M.).

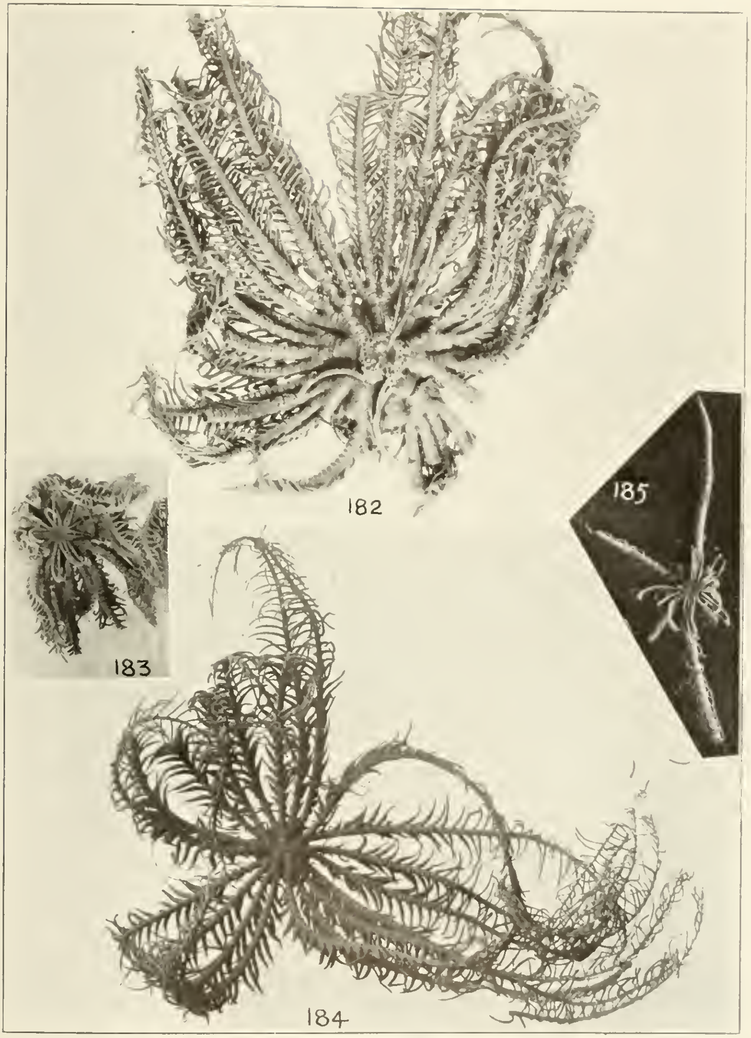
PLATE 65

FIGURE 182. *Comantheria intermedia* from Sagami Bay, Japan; Doctor Haberer, No. 9307 (Munich Mus.).

183. *Comanthus wahlbergii*, one of the cotypes from Durban (Port Natal) (Berl. M., 1060).

184. *Comanthus parvicirra*, a specimen from the Nicobar Islands labeled by Lütken *Antedon mutabilis* (C. M.).

185. *Comissia chadwicki*, the type specimen from off the northeastern coast of Ceylon in 51 meters (I. M.).



COMANTHERIA INTERMEDIA, COMANTHUS WAHLBERGII, C. PARVICIRRA, AND COMISSIA CHADWICKI

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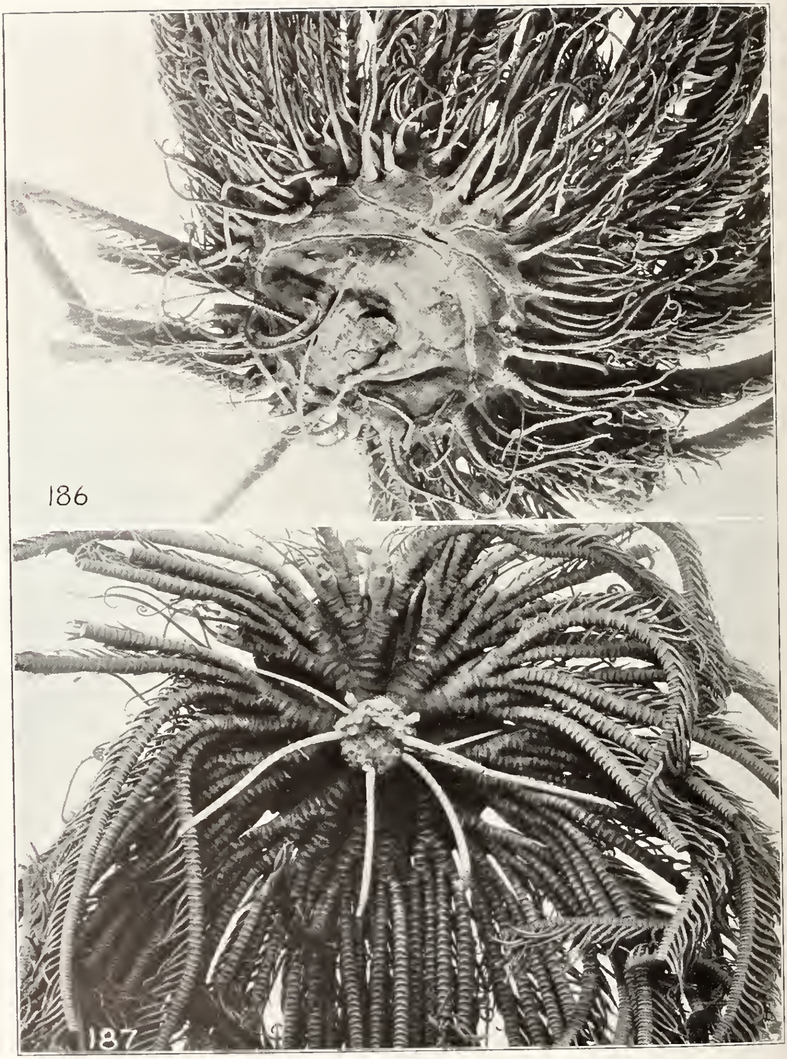


Comanthus bennetti

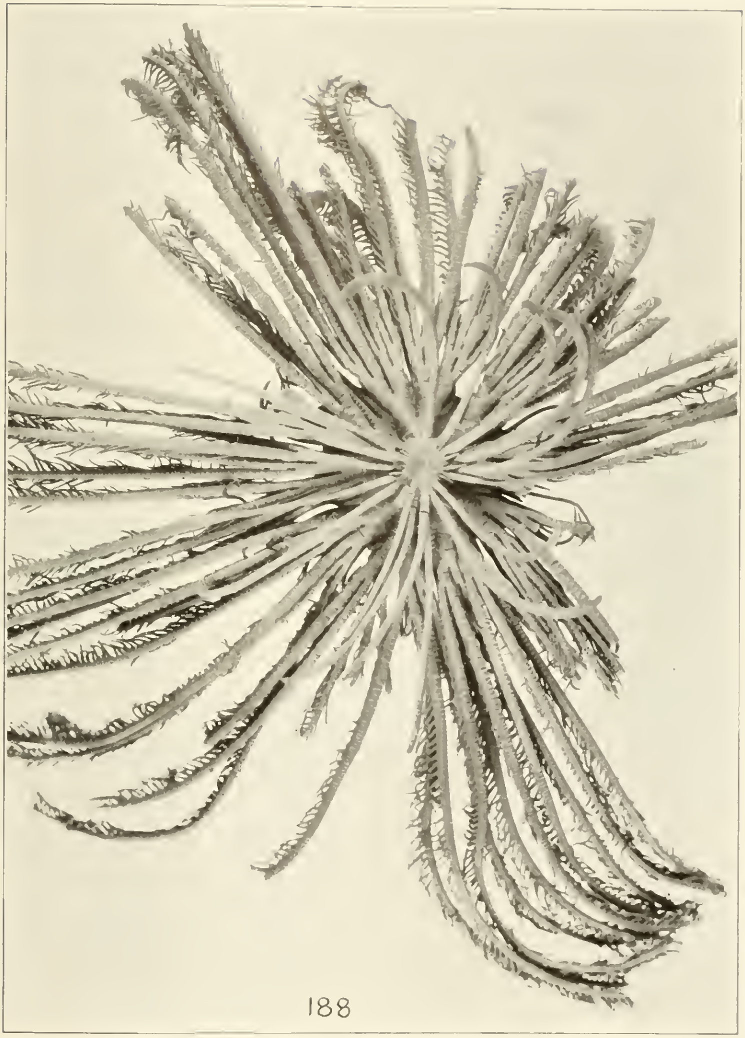
For explanation of plate see page facing.

Plate 66

Figures 186, 187. *Comanthus bennetti*, a specimen from the Pelew Islands labeled by Lütken *Actinometra brachymera* (C. M.).

PLATE 67

FIGURE 188. *Comanthus bennetti* from off Table Island, Andaman Sea, in 27–64 meters.



COMANTHUS BENNETTI

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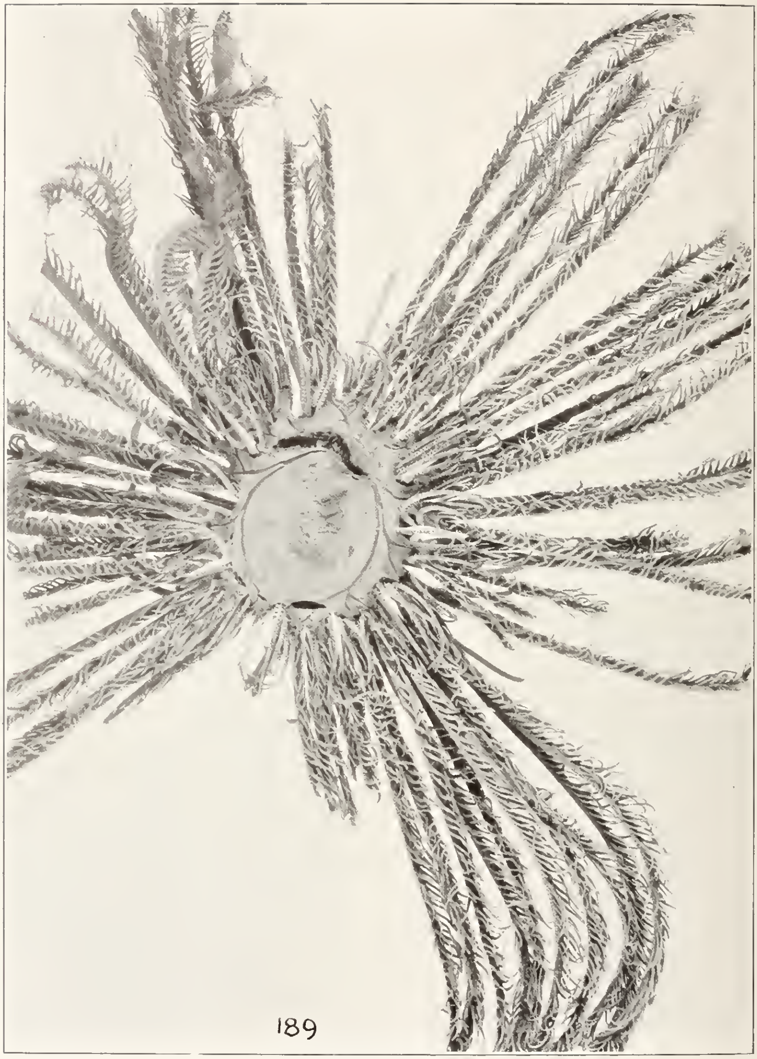


COMANTHUS BENNETTI

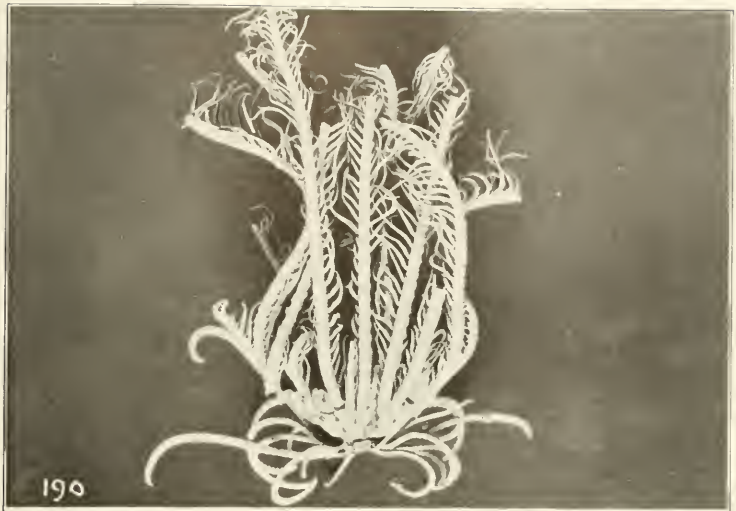
FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 68

FIGURE 189. *Comanthus bennetti*, the specimen shown on the preceding plate (fig. 188), ventral view.

PLATE 69

FIGURES 190, 191. *Comanthus plectrophorum* from the Gippsland coast collected by the *Endeavour.*



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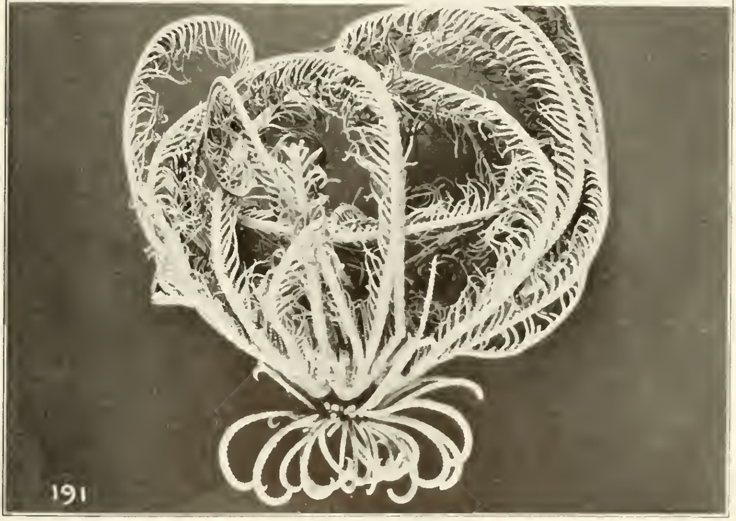

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COMANTHUS PLECTROPHORUM

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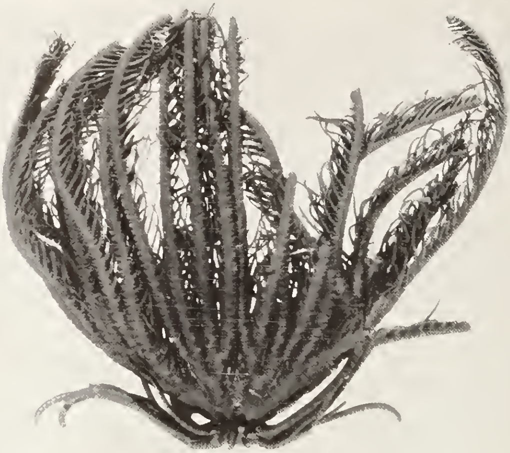

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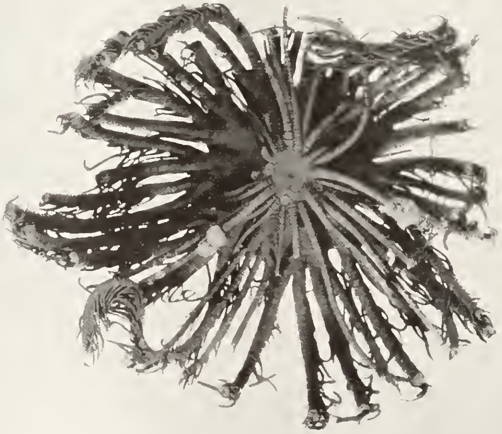


193

Comanthus pinguis

For explanation of plate see page facing

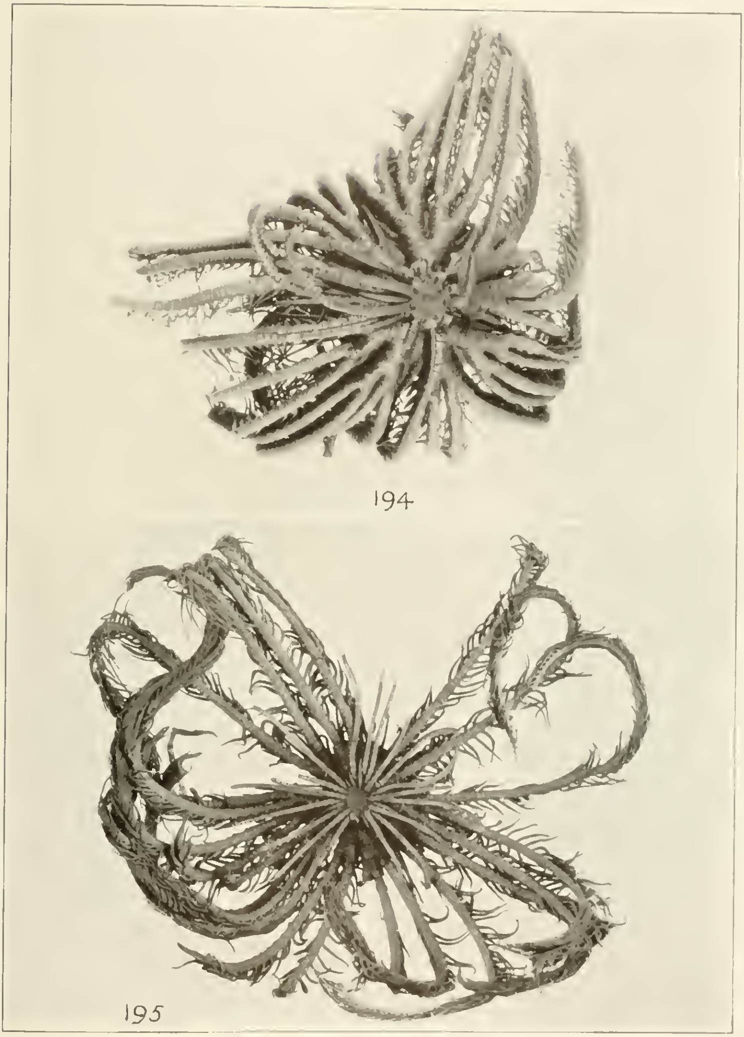
PLATE 70

FIGURES 192,193. *Comanthus pinguis* from *Albatross* station 3718 (U.S.N.M., 35075)

PLATE 71

FIGURE 194. *Comanthus pinguis*, the type specimen from *Albatross* stations 3716–3735 (U.S.N.M., 25517).

195. *Comanthus japonica* from *Albatross* station 4935 (U.S.N.M., 35009).



COMANTHUS PINGUIS AND C. JAPONICA

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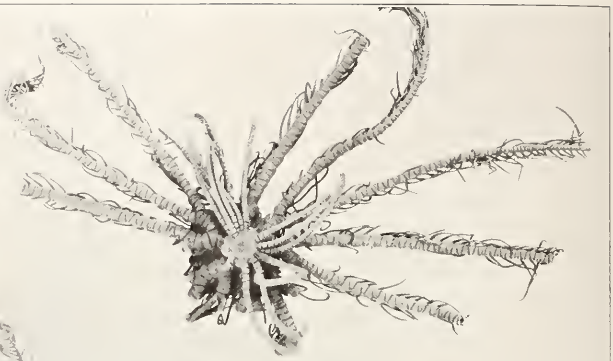

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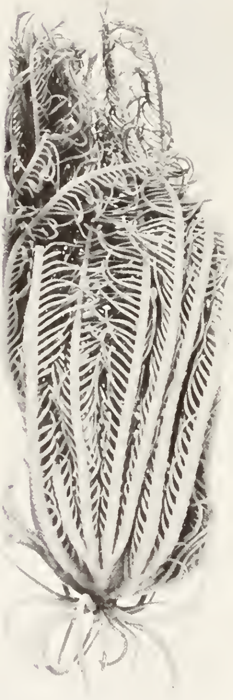

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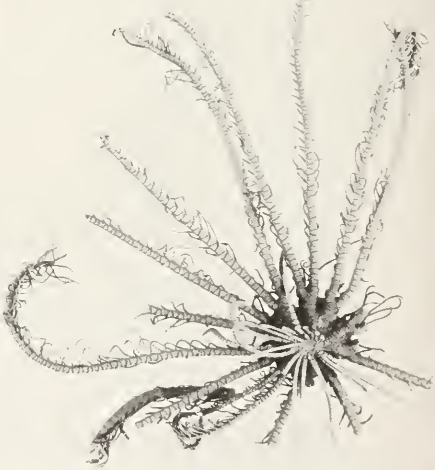

198

COMANTHUS JAPONICA

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PLATE 72

FIGURE 196. *Comanthus japonica* from Sagami Bay, Japan (U.S.N.M., 35003).

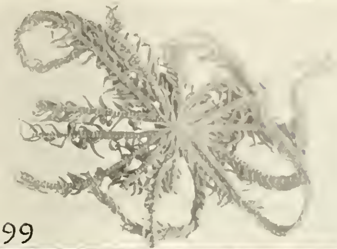
197, 198. *Comanthus japonica* from *Albatross* station 3707 (U.S.N.M., 35028).

PLATE 73

FIGURE 199. *Comanthina belli*, a young specimen from Port Hedland, Western Australia (Berl. M.).

200. *Comanthus parvicirra*, a specimen from Tonga labeled by Lütken *Antedon mutabilis* (C. M.).

201. *Comanthus japonica*, a very large specimen from Fukuura in about 150 meters (Munich Mus.).



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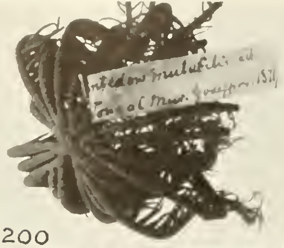

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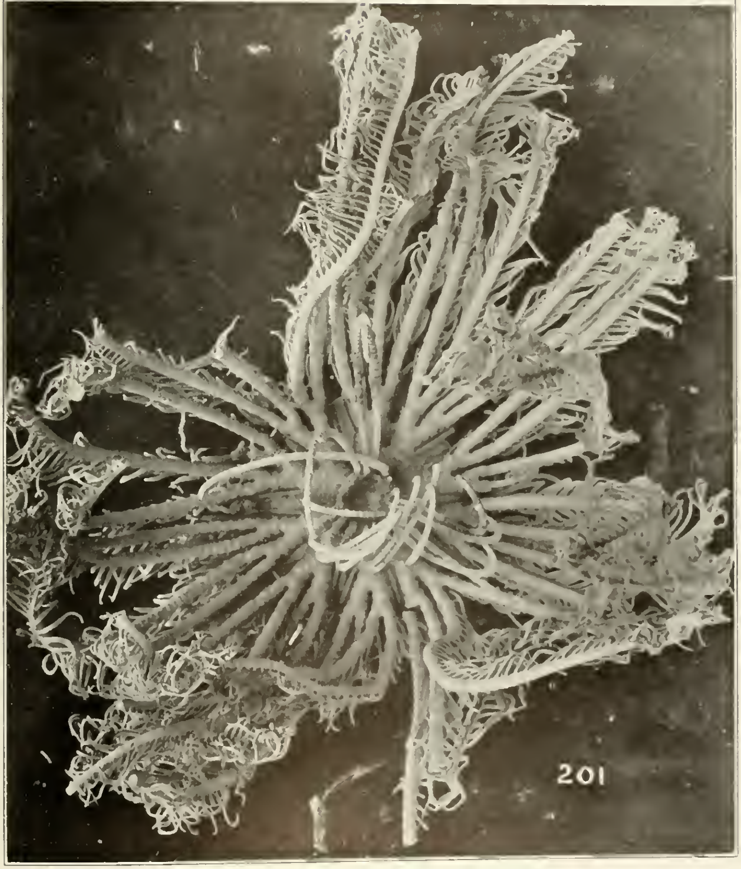

201

COMANTHINA BELLI, COMANTHUS PARVICIRRA AND C. JAPONICA

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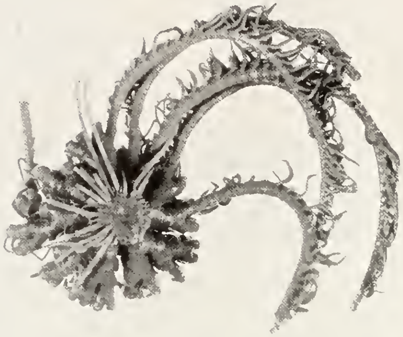

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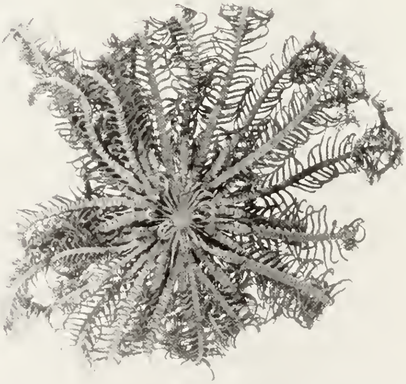

203

COMANTHUS BENHAMI AND C. TRICHOPTERA

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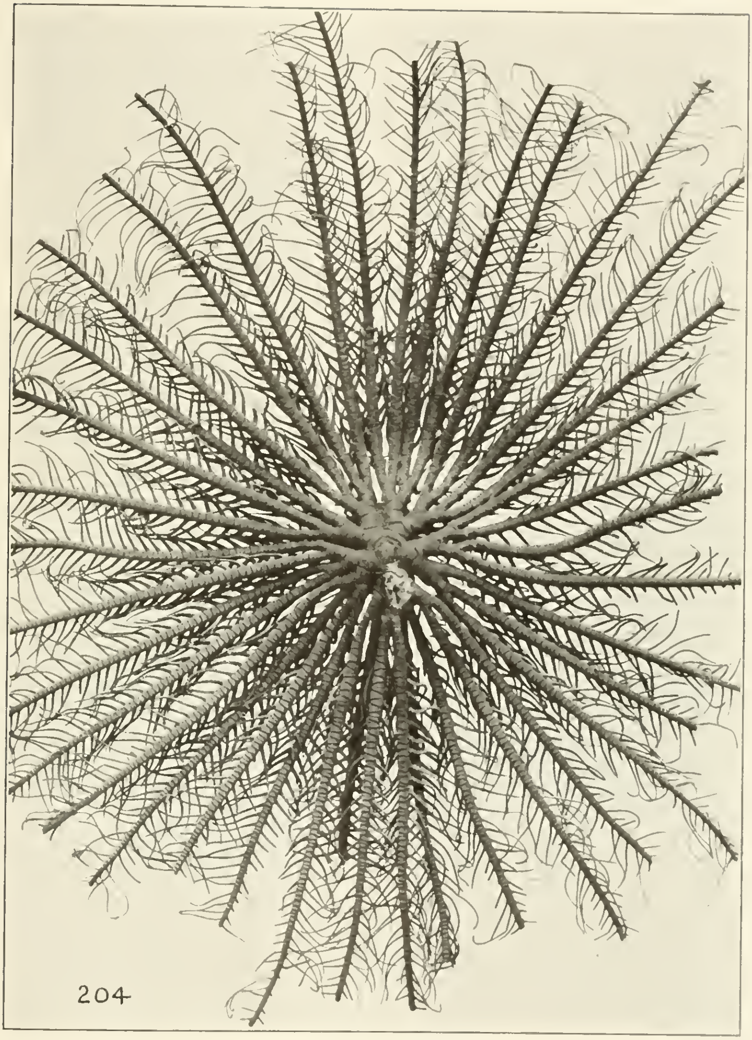
PLATE 74

FIGURE 202. *Comanthus benhami*, the type specimen from Preservation Inlet, New Zealand (U.S.N.M., 38684).

203. *Comanthus trichoptera* collected at Port Jackson, New South Wales, by Dr. Th Mortensen

Plate 75

Figure 204. *Comanthus timorensis* from Torres Strait (U. S. N. M., 36165)



COMANTHUS TIMORENSIS

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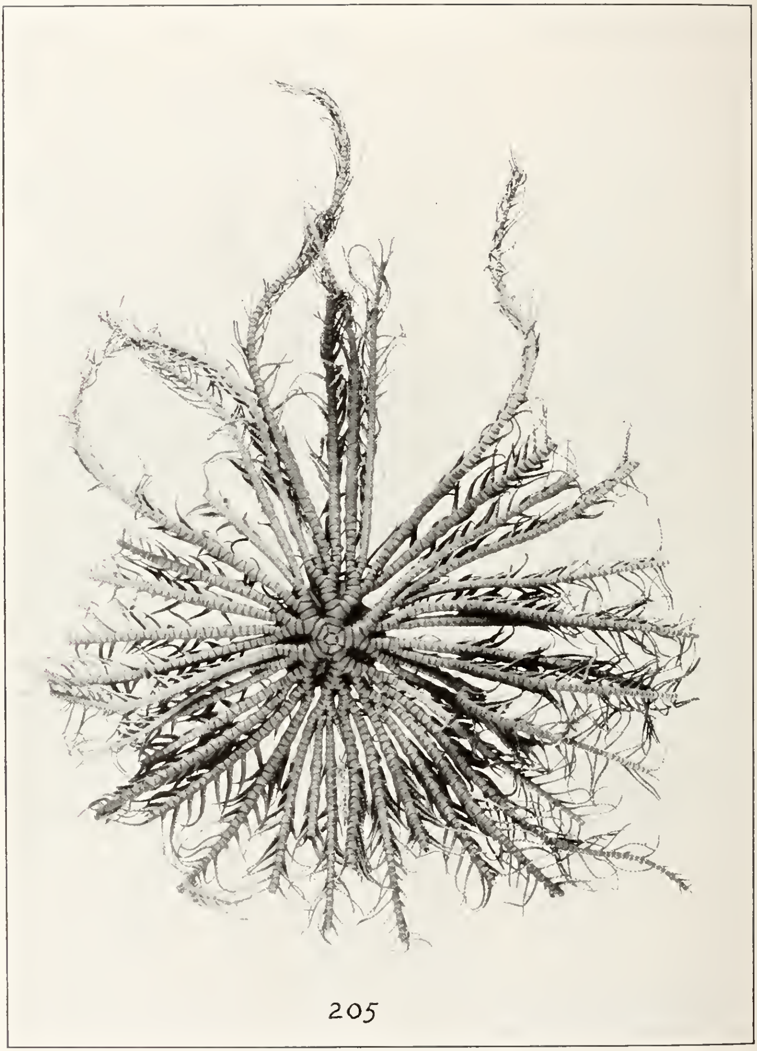


COMANTHUS TIMORENSIS

FOR EXPLANATION OF PLATE SEE PAGE FACING.

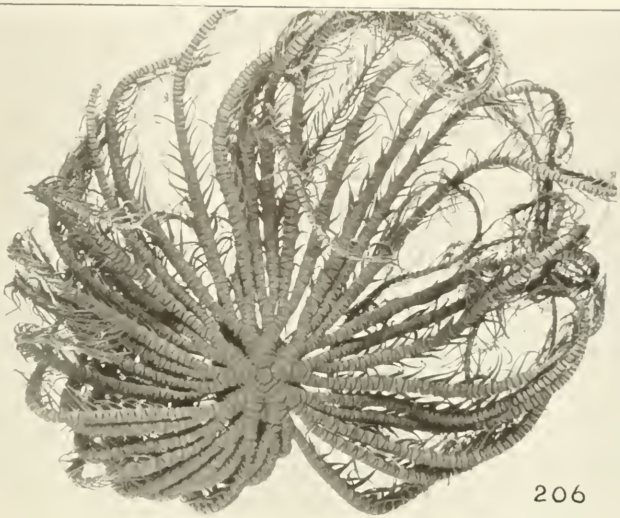
PLATE 76

FIGURE 205. *Comanthus timorensis* from Banda, collected by the Danish Expedition to the Kei Islands.

PLATE 77

FIGURE 206. *Comanthus timorensis* from the Danish expedition to the Kei Islands station 30.

207. *Comanthus timorensis* from Amboina, collected by the Danish expedition to the Kei Islands.



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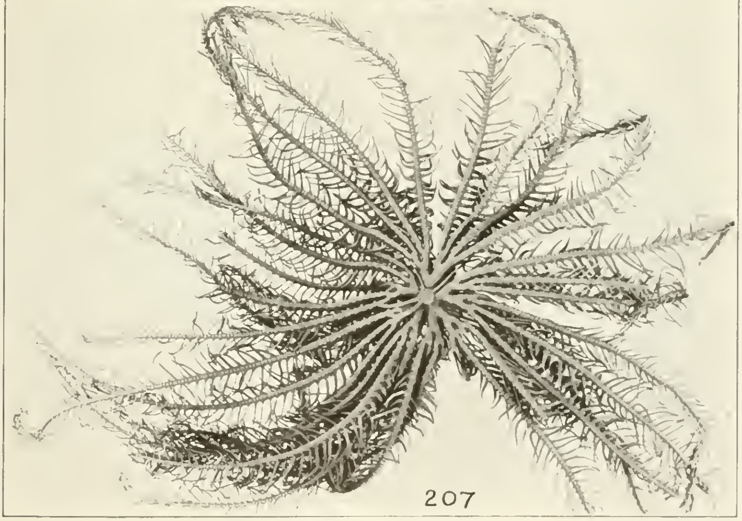
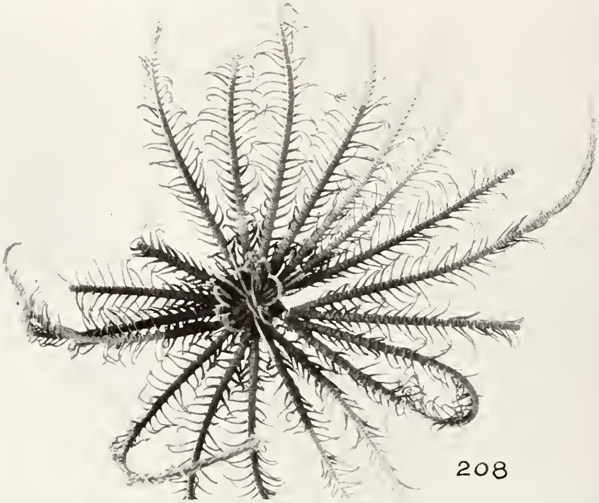


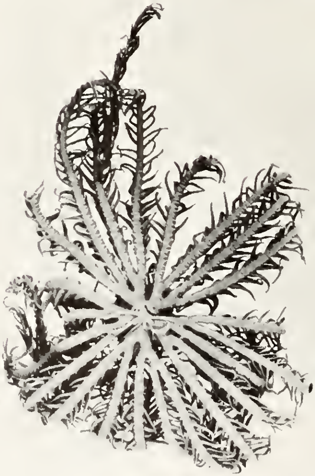
207

COMANTHUS TIMORENSIS

FOR EXPLANATION OF PLATE SEE PAGE FACING.



208



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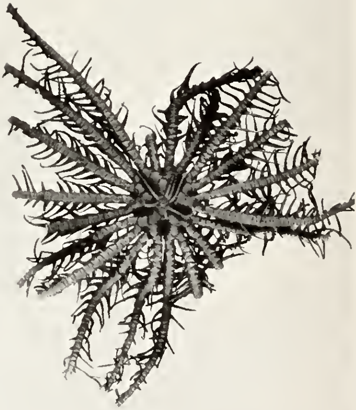


210

COMANTHUS SAMOANA AND C. PARVICIRRA

FOR EXPLANATION OF PLATE SEE PAGE FACING.

PLATE 78

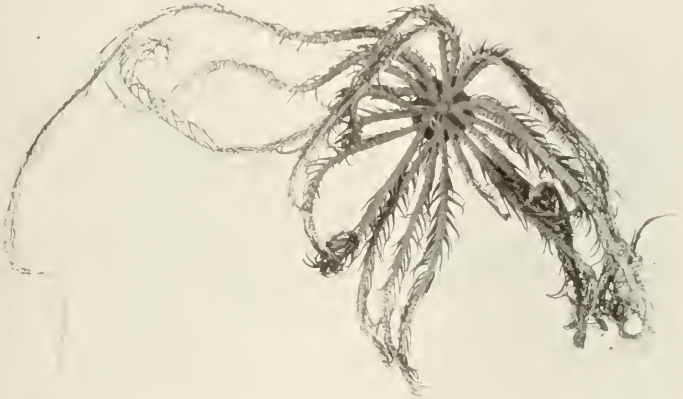
FIGURE 208. *Comanthus samoana*, the type specimen from Samoa (U.S.N.M., 25514)
209. *Comanthus parvicirra* from Galle, Ceylon; *Investigator* collection No. 5D (U.S.N.M., 34979).
210. *Comanthus parvicirra* from Galle, Ceylon; *Investigator* collection No. 15D (U.S.N.M., 35008).

PLATE 79

FIGURE 211. *Comanthus parvicirra* from the Danish expedition to the Kei Islands station 30.

212. *Comanthus parvicirra* from Singapore (C. M.).

213, 214. *Comanthus parvicirra* from Zamboanga, Philippines, collected by the *Challenger* (U.S.N.M., 17525).



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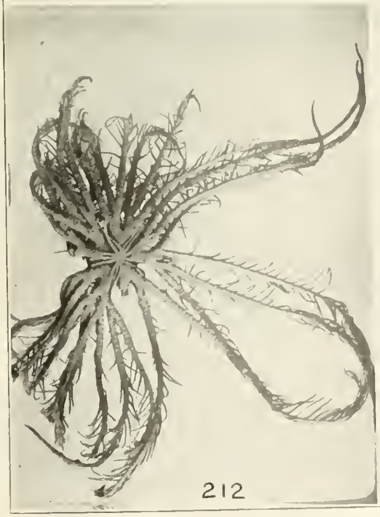

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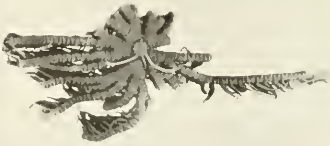

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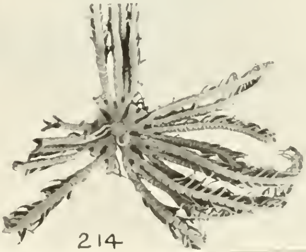
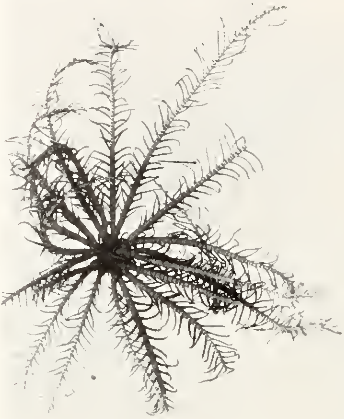


214

Comanthus parvicirra

For explanation of plate see page facing.



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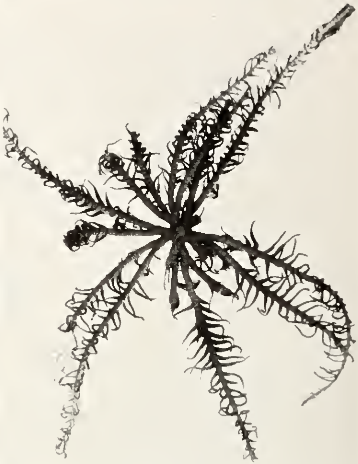

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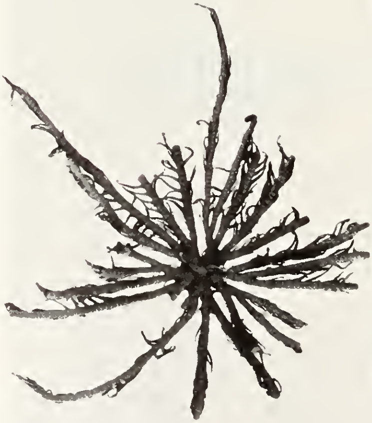
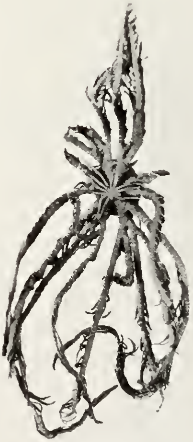


217



218

Comanthus parvicirra

For explanation of plate see page facing.

PLATE 80

FIGURES 215, 216. *Comanthus parvicirra* from the Danish expedition to the Kei Islands station 20.
217. *Comanthus parvicirra* from *Albatross* station 5428 (U.S.N.M., 34980).
218. *Comanthus parvicirra* from Cape St. André, Madagascar (U.S.N.M., 34944).

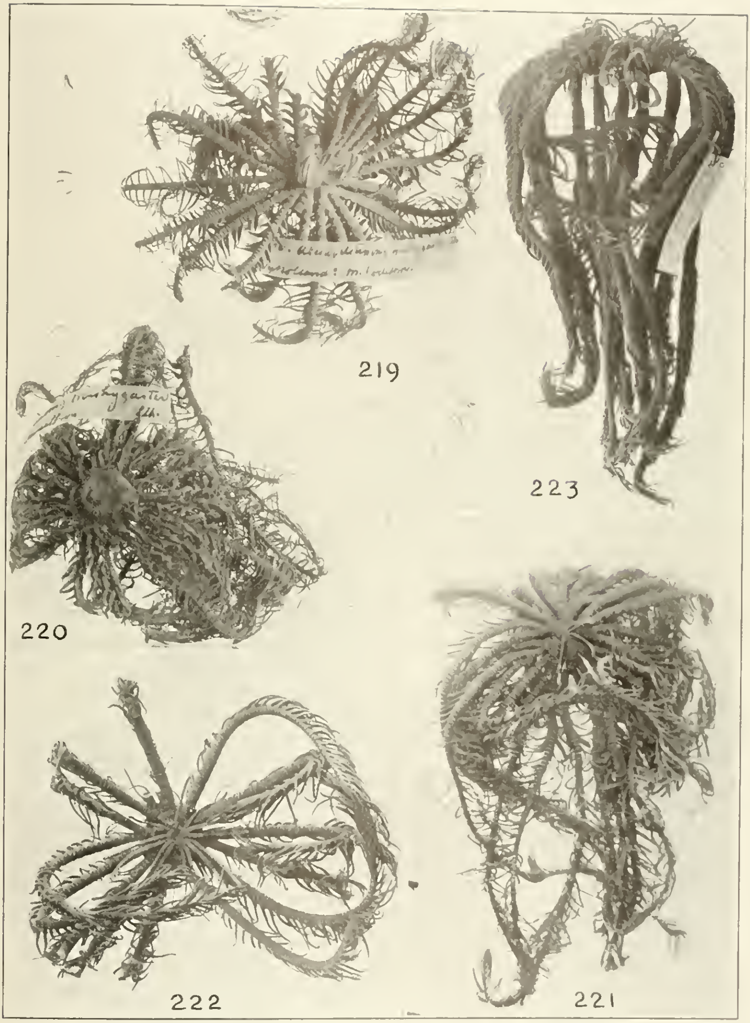
PLATE 81

FIGURES 219, 220. *Comanthus samoana* from ?Australia labeled by Lütken *Alecto* (*Actinometra*) *trochygaster* (C. M.).

221. *Comanthus parvicirra* from Pitulu, Admiralty Islands (H. M.).

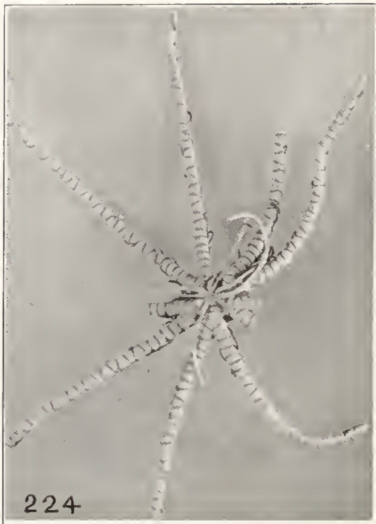
222. *Capillaster multiradiata* from Anger, Java (C. M.).

223. *Capillaster multiradiata* from the Nicobar Islands (C. M.).


219
223
220
brachygaster
222
221

COMANTHUS SAMOANA, C. PARVICIRRA AND CAPILLASTER MULTIRADIATA

FOR EXPLANATION OF PLATE SEE PAGE FACING.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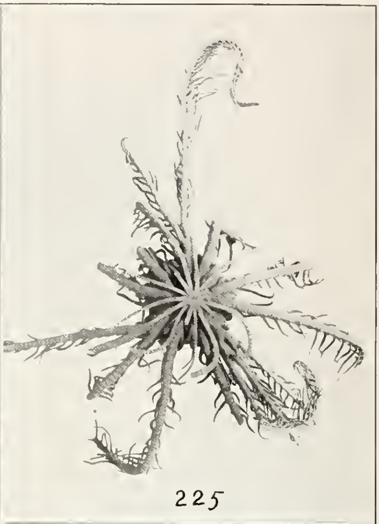
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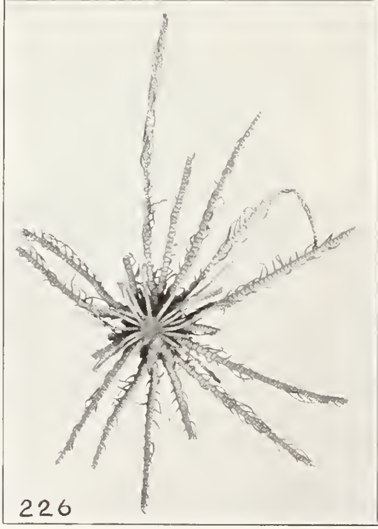
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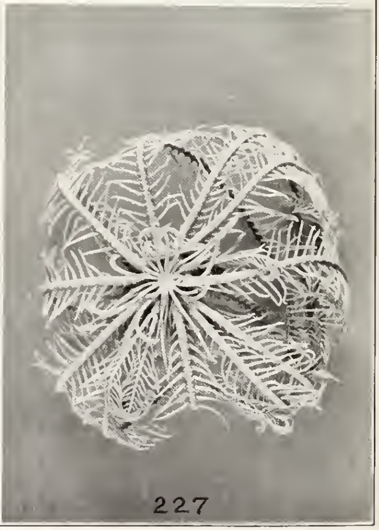
227

Capillaster asterias, Comanthus bennetti, and C. japonica

For explanation of plate see page facing.

Plate 82

Figure 224. *Capillaster asterias*, a young specimen from the Danish expedition to the Kei Islands station 82, ×2.

225. *Comanthus bennetti*, the type specimen of *Comanthus crassicirra* from *Siboga* station 133 (Amsterdam Mus.).

226. *Comanthus japonica*, a young specimen from *Albatross* station 3707 (U.S.N.M., 35028).

227. *Comanthus japonica* from Misaki in 219 meters (U.S.N.M., 35043).

INDEX

Page
abbotti, Antedon 4
    Cenometra 32
    Himerometra 6
abyssicola, Antedon 8, 13, 22
    Bathymetra 13
abyssorum, Antedon 8
    Decametrocrinus 51
    Thaumatocrinus 12
acanthaster, Calometra 30
acerba, Asterometra 38
Achrochordocrinus 53
Aclinometra 307, 457
Aclinometra regalis 8, 467
acoela, Antedon 8
    Poecilometra 8, 17, 21, 34
Acoela group 2, 4, 8
Actimometra 307
actinodes, Comatula 691
Actinomedra 374
Actinomedra meridionalis 377
Actinomerta 307
Actinometer 307
Actinometer discoidea 232
Actinometra 1, 2, 4, 10, 36, 76, 78, 79, 80, 81, 89, 109, 110, 122, 150, 153, 156, 214, 230, 231, 239, 244, 275, 288, 295, 305, 308, 317, 336, 358, 374, 395, 397, 410, 427, 446, 451, 457, 483, 527, 547, 548, 574, 585, 627, 676, 677, 678, 680, 692.
Actinometra affinis 79, 341, 346, 351, 358, 359, 363
    alata 11, 143
    albonotata 325, 331, 337, 338
    alternans 361, 370, 488, 499
    annotea 41, 634
    annulata 604, 616, 617, 628, 629, 630, 677, 678, 682
    armata 41, 632, 675, 676, 677, 678, 681
    aruensis 310, 319
    belli 51, 415, 428, 458
    bennetti 532, 546, 547, 548, 549
    bennettii 533
    blakei 219, 224, 231, 377, 381, 396, 397, 399, 400
    borneensis 36, 37, 176, 206, 208
    brachiolata 297, 302
    brachymera 79, 533, 546, 549

Page
Actinometra brasiliensis 377, 397
    briareus 492, 499, 502
    coccodistoma 212 213
    coppingeri 36, 37, 175, 181, 190, 206, 207, 208, 397
    cristata 57, 231, 289, 399
    cumingi 342, 359, 634, 677
    cumingii 341, 358, 395, 397, 634, 644, 677, 682, 692
    difficilis 49, 154, 155
    discoidea 206, 207, 232, 235, 239
    dissimilis 466, 477, 481, 482
    distincta 448, 451
    divaricata 492, 497, 499, 502, 503
    duplex 466, 472, 473, 481, 482, 493
    echinoptera 142, 229, 231, 238, 294, 295, 342, 397, 398
    echinoptera var. alata 280, 377
        aplanata 125, 400
        carinata 231, 276, 279, 280, 398
        carinata-discoidea 276, 283, 399
        carinata-pulchella 125, 276, 283, 399
        carinata-rubiginosa 226, 232, 399
        discoidea 219, 224, 232, 235, 239, 280, 399
        echinoptera 378, 381, 398
        lineata 280
        (?) lineata 219, 226, 232, 399
        meridionalis 128, 231, 277, 280, 283, 326, 339, 378, 381, 382, 383, 385, 398.
        meridionalis-carinata 129, 277, 280, 283, 378, 398
        meridionalis-pulchella 125, 130, 399
        meridionalis-rubiginosa 226, 229, 232, 378, 398
        meridionalis-valida 378, 382, 383, 398
        multicirra 219, 224, 400
        pulchella 125, 127, 128, 136, 137, 145, 146, 150, 280, 378, 379, 399
        pulchella, subvar. alata 127, 134, 136, 137, 143, 145, 146, 147, 399.
            planata 125, 127, 128, 131, 133, 134, 135, 136, 137, 145, 399.
            pulchella 399
        rubiginosa 226, 232, 280, 379, 398

Page
Actinometra echinoptera rubiginosa-discoidea 232, 238, 239, 400
 valida 378, 381, 382, 383, 398
 valida-meridionalis 379, 381, 400
elongata 22, 406, 634, 640, 645, 665, 676, 678, 679, 680, 681
elongata var 634
fimbriata 175, 177, 180, 206, 208, 212, 213
fusca 79, 112, 117
gracilis 79, 175, 205, 207, 430, 605
grandicalyx 502, 513, 533, 549
guttata 41, 79, 604, 629, 679, 681
iaponica 564
imperialis 78, 79, 324, 328, 332, 333, 335, 336, 337, 338, 370
intermedia 325, 337, 338
intricata 30, 603, 604, 627, 628, 629, 632, 674, 679, 681
iowensis 219, 224
japonica 564, 570, 575
japonica var. morsei 565, 570, 575
jukesi 310, 318
jukesii 47, 310, 318, 319, 681
linearis 226
lineata 206, 207, 225, 230, 231, 239
litoralis 604, 629
littoralis 408, 604, 610, 628, 629, 664, 681
macrobrachius 79, 158
maculata 99, 110, 111, 112, 156
magnifica 109, 492, 499, 502
meridionalis 229, 231, 294, 295, 376, 395, 396, 397
meridionalis var. carinata 276, 283, 377, 396
 quadrata 377, 396
meyeri 41, 604, 618, 627, 628, 629, 677, 678, 681, 682
monobrachius 158
morsei 564, 570, 575
multibrachiata 428, 437
multifida 11, 414, 415, 421, 427, 428, 429, 458, 464, 466, 481, 482, 512, 513
multiradiata 46, 113, 117, 118, 161, 168, 169, 170, 174, 205, 206, 207, 532
mutabilis 41, 634, 638, 644, 647, 677, 678, 679, 681
nigra 37, 92, 110
nobilis 41, 458, 464, 466, 472, 477, 482
notata 88, 98, 101, 109, 110, 111, 121, 294
novae-guineae 415, 428, 437, 466, 481
parvicirra 37, 176, 207, 257, 408, 444, 446, 447, 448, 451, 467, 482, 492, 502, 548, 589, 592, 593, 596, 598, 604, 610, 628, 629, 632, 638, 676, 677, 678, 679, 680.

Page
Actinometra parvicirra typus A 593, 596, 598, 601, 602, 628, 647, 649, 679
 B 596, 598, 601, 602, 629, 647, 679
parvicurva 634
pauciciria 310
paucicirra 47, 109, 155, 310, 315, 318, 319, 342, 589, 681
pectinata 46, 269, 270, 302, 336, 341, 342, 357, 358, 359, 361, 370
peregrina 248, 249
peroni 533, 537, 548
peronii 533, 538, 547, 549
polymorpha 41, 80, 598, 604, 619, 621, 627, 628, 632, 646, 652, 653, 654, 655, 658, 661, 663, 675, 676, 677, 678, 681.
pulchella 11, 18, 112, 115, 118, 124, 142, 143, 149, 150, 152, 154, 155, 156, 231, 294, 295, 396, 397
purpurea 342, 358, 361, 370
quadrata 406, 408, 634, 638, 646, 658, 664, 665, 678, 681
regalis 437, 439, 467, 472, 473, 474, 475, 481, 482, 548
robusta 80, 325, 328, 329, 330, 331, 336, 337, 338, 339, 358
robustipinna 46, 52, 533, 549, 553, 563
rosea 297, 302
rotalaria 47, 49, 317, 628, 632, 658, 664, 679, 680, 681
rubiginosa 225, 229, 231, 239, 294, 295, 377, 397
schlegeli 466
schlegelii 466, 471, 481, 482
sentosa 36, 37, 161, 206
simplex 41, 99, 110, 111, 118, 406, 634, 645, 664, 665, 678, 679, 680, 681
solaris 302, 318, 320, 324, 337, 339, 341, 357, 361, 370
solaris var. albonotata 325, 337
spinipinna 565, 571, 575, 586
stellata 79, 414, 426, 427, 428, 431
stelligera 92, 98, 118
stewarti 176, 206
stilligera 98
strata 326
striata 326
strota 320, 325, 331, 333, 338
tenax 79, 98, 110
trachigaster 634
trachygaster 41, 79, 593, 601, 602, 628, 679, 681
trichoptera 565, 570, 571, 575, 580, 585
tridistichata 431, 433

Page
Actinometra typica 415, 427, 428, 430, 433, 467, 482, 493
valida 41, 604, 613, 628, 629, 664, 679, 682
variabilis 36, 415, 421, 427, 428, 429, 634, 682
wahlberghii 589
wahlbergi 589
wahlbergii 589
sp 98, 108, 112, 118, 124, 218, 225, 270, 325, 341, 430, 434, 448, 492, 553, 563, 564, 575, 604, 632, 633, 691, 692, 693.
sp. juv 342, 358, 377
sp. nov 269, 466, 481, 633, 692
Actinometra (Comatella) stelligera 36
Actinometra (Comatula) 527
Actinometra (Comatula) armata 628, 632
Actinometra (Neocomatella) pulchella 153
Actinometridae 5, 76, 81
Actrinometra 527
Actrinometra trachygaster 593
Actynometra 122, 307, 308
Actynometra jukesii 310
pulchella 150
strota 326
aculeata, Charitometra 8, 27
Chlorometra 34
acuta, Himerometra 10
Stenometra 50
Stephanometra 32
acuticirra, Craspedometra 32, 157
acutiradia, Antedon 33
Stiremetra 33
Thalassometra 7
acutus, Metacrinus 25
Adelometra 8, 14, 15, 39, 58
Adelometra angustiradia 8
tenuipes 15
adeonae, Antedon 8
Comatula 23, 47
Oligometra 12, 32
Oligometrides 55, 506, 511
adrestine, Antedon 5, 8, 12
Iridometra 12, 21
adriani, Antedon 34
Anthometra 55
adriatica, Antedon 43, 56
aegyptica, Iridometra 46
aequipinna, Toxometra 59
Aetinometra 527
Aetinometra parvicirra 633
affinis, Actinometra 79, 341, 346, 351, 358, 359, 363
Comatula pectinata 352

Page
affinis, Heterometra 32
Himerometra 6
afra, Antedon 22
Dichrometra flagellata var 51
Perometra 46
Tropiometra 5, 20, 51, 55
africana, Amphimetra 46
agassizii, Thalassometra 7, 33
Aglaometra 55
Aglaometra incerta 55
valida 55
alata, Actinometra 11, 143
Actinometra echinoptera var 280, 377
Actinometra echinoptera var. pulchella, subvar 127, 134, 136, 137, 143, 145, 146, 147, 399
Antedon 39, 125, 142, 149
Comaster 11, 125
Comaster (Neocomatella) 18
Comatella 125
Neocomatella 124 (in key), 125, 142, 280; pl. 7, fig. 22
Neocomatella pulchella var 399
Phanogenia 24, 125
alaudae, Decametra 46
alboflava, Antedon 4
Thalassometra 7, 21
albonotata, Actinometra 325, 331, 337, 338
Actinometra solaris var 325, 337
albopurpurea, Cyllometra 9, 15, 20, 31
alcyon, Thaumatometra 51
aldrichianus, Bathycrinus 3, 45
Alecto 1, 2, 22, 78, 156, 295, 305, 308, 374, 409, 527, 585
Alecto bennetti 41, 80, 532, 541, 545
brachiolata 296, 301
echinophora 376
echinoptera 37, 79, 80, 376, 382, 394, 395
elongata 680
fimbriata 174
flagellata 53
horrida 22
japonica 80, 564, 574, 575
macronema 7, 10
meridionalis 376, 394, 395
multifida 35, 37, 47, 80, 168, 169, 204, 414, 425, 428, 429, 510, 512, 513, 544, 545
multiradiata 161, 174, 414
novae-Guineae 10, 80, 413, 425, 426, 427, 429, 442, 481
parvicirra 30, 41, 49, 79, 80, 628, 629, 631, 644, 661, 674, 675, 676, 681
phalangium 12
philiberti 47

Page
Alecto purpurea 43, 79, 80, 336, 337, 359, 360, 370, 371
  rosea 48, 79, 80, 296, 298, 301
  rotalaria 309, 317
  savignii 23
  solaris 324, 335
  timorensis 41, 80, 603, 609, 627, 630, 639, 676, 677, 681, 683
  trichoptera 80
  wahlbergii 41, 79, 80, 588, 592, 677, 678, 681, 682
alecto, Calometra 44
Alectro dentata 12, 394
aliena, Craspedometra 38
Allagecrinus 137
altera, Luna marina 357, 694
alternans, Actinometra 361, 370, 488
  Comantheria 483, 484 (in key), 488, 502
  Comanthus 30, 36, 489, 492
  Comaster 11, 489
  Phanogenia 24, 489
alternata, Antedon 8
  Thaumatometra 12, 17, 21
alternicirrus, Endoxocrinus 16, 23, 26, 36
amboinae, Craspedometra 52
Amphihelia 152
Amphimetra 32, 39
Amphimetra africana 46
  anceps 32
  discoidea 41, 48, 55
  ensiformis 32
  flora 55
  formosa 41
  laevissima 32
  milberti 32
  molleri 32
  mortenseni 38, 47
  papuensis 55
  parilis 38
  producta 32
  propinqua 50
  schlegelii 32
  ?tessellata 32
  variipinna 32
Analcidometra 45
Analcidometra armata 675
anceps, Amphimetra 32
  Himerometra 6, 31
andersoni, Antedon 6, 53
andromeda, Zygometra 50
Andrometra 58
angulatus, Metacrinus 10, 21, 25
angusticalyx, Charitometra 8
  Pachylometra 34

Page
angustipinna, Antedon 8
  Isometra 13, 14
angustiradia, Adelometra 8
  Antedon 8, 22
Anilocra 318
Annacrinus 60
annandalei, Crotalometra 38
annotea, Actinometra 41, 634
annulata, Actinometra 604, 616, 617, 628, 629, 630, 677, 678, 682
  Comanthus 599, 605, 643, 682, 683
  Comanthus (Comanthus) 605, 630
  Comanthus (Vania) 48, 55, 605, 629, 631
  Vania 606
  var. xantha, Comanthus 606
annulatum, Comanthus 602, 605
  xanthum, Comanthus 606
  var. xanthum, Comanthus 606, 615, 630, 631
annulatus, Comanthus 606
anomala, Cyllometra 29, 31
  Psathyrometra 51
anomalus, Atelecrinus 51
antarctica, Antedon 49
  Heliometra 6
antarcticus, Ptilocrinus 26, 31
Antedon 1, 2, 5, 9, 12, 14, 15, 16, 19, 27, 36, 43, 56, 58, 65, 79, 80, 89, 109, 122, 142, 156, 203, 214, 224, 230, 231, 284, 288, 292, 307, 351, 374, 384, 395, 411, 422, 423, 483, 527, 548, 549, 574, 627, 692.
Antedon abbotti 4
  abyssicola 8, 13, 22
  abyssorum 8
  acoela 8
  acutiradia 33
  adeonae 8
  adrestine 5, 8, 12
  adriani 34
  adriatica 43, 56
  afra 22
  alata 39, 125, 142, 149
  alboflava 4
  alternata 8
  andersoni 6, 53
  angustipinna 8
  angustiradia 8, 22
  antarctica 49
  anthus 4, 7
  arctica 3, 8
  aspera 12
  asperrima 3
  aster 4

Page

Antedon australis 9
balanoides 39
bassett-smithi 22, 36, 98, 110, 111
bidens 47
bifida 1, 8, 17, 27, 28, 45, 56, 142, 203, 356, 396
bowersi 4
brachymera 3
brevicirra 444, 446, 447, 451
brevipinna 18
briareus 41, 492, 502
briseis 3, 8
callista 4, 8
capensis 9, 22, 589, 592
carpenteri 8
challengeri 9
ciliata 3, 9, 12
clarae 51
clemens 20
clio 3, 46
columnaris 6
compressa 14
crassipinna 6
cumingii 342, 359
cupuliferus 30
delicatissima 4
dentata 9
diadema 4
diomedeae 4, 7
discoidea 4, 8
distincta 34
dübeni 9
dübenii 14, 56
duplex 34
elegans 37
emendatrix 46
erinacea 33, 53
erythrizon 3
eschrichti var. magellanica 22
eschrichtii maxima 3, 4
exigua 9
fieldi 22
fimbriatus 175
finschii 33
flava 14, 34
flavopurpurea 4, 52
flexilis 58
fluctuans 37
fragilis 3, 6
garrettiana 4, 34
gorgonia 22
gracilis 9
granulifera 17, 18, 142

Page

Antedon hagenii 12, 13
hana 4, 57
hartlaubi 3, 23
hawaiiensis 4
hepburniana 4, 34
hirsuta 9
hondoensis 3
hupferi 9, 45, 56
imparipinna 53
incerta 34, 36
incisa 8
indica 430, 434
inexpectata 3
insignis 22, 23
irregularis 342, 358
isis 3, 9
japonica 9
klunzingeri 52
laevis 9, 58
laodice 3
lata 4
latipinna 34
lineata 9, 13, 14
lineatus 9, 14
longicirra 7
longipinna 9, 58
lovéni 9, 12, 22, 23
ludovici 52
lusitanica 34
macrodiscus 22
macropoda 4, 7
magnicirra 14, 22, 34, 36
manca 7
mariae 3
mediterranea 27, 45, 56, 203, 356, 357
meridionalis 124, 376
mertensi 41, 634
microdiscus 5
milberti 325, 337
minor 4, 5, 9, 21
minuta 5, 9
moluccana 51
moorei 22
moroccana 56
multicolor 4, 52
mutabilis 652, 677
nana 9, 58
orientalis 5, 9, 21
orion 4, 14, 33
parvicirra 9
parvula 9
perplexa 3
perspinosa 31

Page

- Antedon petasus 27, 56, 384, 661
  - phalangium 9
  - porrecta 14, 34
  - pourtalèsi 17, 18
  - prolixa 9
  - propinqua 4
  - psyche 9, 10, 58
  - pubescens 4
  - pulchella 124, 131, 133, 135, 142, 149
  - pumila 9, 12, 22
  - quadrata 52
  - quinquecostata 4, 33
  - rara 3
  - rathbuni 3
  - reginae 51
  - remota 9, 58
  - rhomboidea 22
  - ruber 4, 12
  - rubiginosa 225, 230
  - rubroflava 4
  - scalaris 4
  - sclateri 14, 22
  - separata 4
  - serrata 9, 10
  - serratissima 3
  - serripinna 9, 12, 46
  - solaris 324
  - spicata 46
  - spinifera 10
  - stella 9, 22
  - stellatus 422
  - stylifer 4
  - tenax 98, 109
  - tenella 9
  - tenelloides 3, 6
  - tenera 51
  - tenuicirra 9, 14
  - tenuis 3, 9
  - thetis 4
  - tigrina 4
  - triqueta 691
  - tuberosa 34
  - typica 415
  - valida 34, 36
  - versicolor 4, 52
  - vicaria 23
  - villosa 4, 7
  - wilsoni 48, 49
  - sp 225, 230, 231, 289, 604, 607, 627, 694
- Antedon (Actinometra) robustum 326, 338
  - (Poecilometra) scalaris 17
- Antedonidae 5, 14, 15, 20, 26, 27, 39, 51, 58, 59, 65, 71 (in key), 73 (in key), 157, 215, 284, 287, 289

Page

- Antedoninae 39, 58, 61, 63, 65
- Antedonoida 28
- Anthometra 55, 57, 58
- Anthometra adriani 55
- anthus, Antedon 4, 7
  - Asterometra 21
  - Ptilometra 7
- aphrodite, Iridometra (Eumetra) 51
- Apiocrinidae 53
- Apiocrinus 53
- Apiocrinus recubariensis 38
- aplanata, Actinometra echinoptera var. 125, 400
- arabica, Decametra 52
- arachnoides, Stenometra 36
- aranea, Dichrometra 35
  - Perissometra 59
- arctica, Antedon 3, 8
- Argyrometra 58
- Argyrometra mortenseni 58, 59
- armata, Actinometra 41, 632, 675, 676, 677, 678, 681
  - Actinometra (Comatula) 628, 632
  - Analcidometra 675
- Articulata 53
- articulata, Dichrometra 33
  - Himerometra 6
- aruensis, Actinometra 310, 319
- asper, Teliocrinus 60
- aspera, Antedon 12
  - Heterometra 41
  - Trichometra 12, 13, 15
- asperrima, Antedon 3
  - Heliometra 6
- aster, Antedon 4
  - Thalassometra 7, 20, 27, 33
- Asteria 302
- asteria, Encrinus 35
  - Encrinus (Encrinus) 35
  - Isis 35, 60
  - Isocrinus (Cenocrinus) 16, 26
- Asterias 1, 156, 302
- Asterias multiradiata 10, 35, 78, 79, 80, 168, 173, 203, 204, 208, 428, 429, 512, 513, 531, 545
  - pectinata 78, 79, 80, 173, 203, 204, 336, 337, 339, 356, 357, 694
  - radiata 341
- Asterias (Comatula) multiradiata 36
  - (Euryale) 302
  - (Euryale) pectinata 340
  - (Ophiura) 156
  - (Ophiura) multiradiata 174
- asterias, Capillaster 157, 158 (in key), **160**; pl. 13, fig. 33; pl. 82, fig. 224
- Asteroidea 40

Page
Asterometra 7, 10, 14, 15, 26, 49, 61, 63
Asterometra acerba 38
  anthus 21
  cristata 44
  lepida 29
  macropoda 21, 64
  magnipeda 44
  mirifica 38
Asterometridae 61, 63, 64
Astroradiata, Echinodermata 40
Atelecrinidae 5
  15, 39, 51, 61, 62, 63, 64, 65, 71 (in key), 72 (in key), 73 (in key), 157, 284.
Atelecrinus 1, 2, 4, 5, 15, 284
Atelecrinus anomalus 51
  conifer 15
  helgae 52
  pourtalèsi 4
  sulcatus 51
atlantica, Neocomatella 55, 125
atlanticus, Eudiocrinus 19
  Pentametrocrinus 13, 45
ater, Craspedometra 46
Atopocrinus 51, 284
Atopocrinus sibogae 51
attenuata, Thalassometra 38
audouini, Tropiometra 52
Austinocrinus 53
australis, Antedon 9
  Bathycrinus 23, 27
  Comatulides 401 (in key), **403**; pl. 45, figs. 138, 139
  Cominia 49, 403
  Craspedometra 32
  Encrinus 49
  Ptilometra 64, 108
Austrometra 57
Austrometra thetidis 59
Balanocrinus 53
balanoides, Antedon 39
  Perometra 7
Balanometra 39, 58, 284
balfouri, Pentacrinus 23
barbata, Comatula 340
  Stella (Decameros) 357
bartschi, Himerometra 30, 32
basicurva, Charitometra 8, 27, 34
Basicurva group 2, 4, 5, 7, 8, 22
bassett-smithi, Antedon 22, 36, 98, 110, 111
  Calometra 8, 99
batheri, Metacrinus 35
batheri var. gracilis, Metacrinus 52
Bathycrinus 3, 9, 14, 27, 42, 43, 53, 57

Page
Bathycrinus aldrichianus 3, 45
  australis 23, 27
  campbellinus 3
  caribbeus 10, 14
  carpenteri 27
  complanatus 5, 37
  equatorialis 10, 14
  gracilis 45
  pacificus 2, 21
  paradoxus 38
  perrieri 45
  recuperatus 45
  serratus 14
  woodmasoni 38
Bathymetra 13, 14, 15, 27, 39, 58
Bathymetra abyssicola 13
  brevicirra 13, 15
  carpenteri 13, 15
  minutissima 13, 15
Bathymetrinae 39, 61, 63, 64, 65
bella, Cenometra 32
  Himerometra 6
belli, Actinometra 51, 415, 428, 458
  Comantheria 459
  Comanthina 48, 424, 429, 457, **458**, 468, 514, 529; pl. 53, fig. 157; pl. 73, fig. 199.
  Comanthus 458
  Comaster 11, 430, 458
  Cyllometra 7, 9, 23
  Phanogenia 24, 458
bengalensis, Heterometra 32
  Himerometra 6, 31
benhami, Comanthus 59, 529, 531 (in key), 584, 586, **587**, 588; pl. 74, fig. 202.
  Comanthus trichoptera 57, 587
bennetti, Actinometra 532, 533, 546, 547, 548, 549
  Alecto 41, 80, 532, 541, 545
  Comanthus 87, 168, 204, 405, 426, 481, 519, 529, 530 (in key), **531**, 553, 555, 556; pl. 66, figs. 186, 187; pl. 67, fig. 188; pl. 68, fig. 189; pl. 82, fig. 225
  Comanthus (Bennettia) 534
  Comanthus (Cenolia) 534
  Comanthus (Comanthus) 533
  Comaster 11, 514, 533
  Comatula 79, 532, 545
  Phanogenia 24, 533
Bennetti group 80
Bennettia 39, 41, 57, 530
Bennettia pinguis 39
  samoana 39

Page

- biarticulata, Heliometra glacialis ... 29
- bidens, Antedon ... 47
  - Oligometra ... 12, 32, 37
  - Himerometra ... 6
- bifida, Antedon ... 1, 8, 17, 27, 28, 45, 56, 142, 203, 356, 396
- bigradata, Psathyrometra ... 6
- bimaculata, Dichrometra ... 33
  - Himerometra ... 6
- bipartipinna, Craspedometra ... 32
- bispinosa, Thalassometra ... 7, 27, 33
- blakei, Actinometra ... 219, 224, 231, 377, 381, 396, 397, 399, 400
  - Encrinus (Isocrinus) ... 35
  - Isocrinus ... 25
  - Isocrinus (Isocrinus) ... 16, 26
- Blastoidea ... 40
- bocki, Didontometra ... 59
- Bohadschoidea ... 40
- Boltenia ... 35
- boltenii, Encrinus ... 35
- Bonasa umbellata ... 42
- borealis, Decametrocrinus ... 21
  - Metacrinus superbus ... 25, 26
  - Psathyrometra ... 15
- borneensis, Actinometra ... 36, 37, 176, 206, 208
  - Comaster ... 11, 24, 25, 176, 207
  - Comatula (Actinometra) ... 175, 183, 205
- Bourgueticrinidae ... 53, 57, 58
- Bourgueticrinus ... 53
- bowersi, Antedon ... 4
  - Nanometra ... 21
- brachiolata, Actinometra ... 297, 302
  - Alecto ... 296, 301
  - Comatula ... 48, 79, 80, 296, 301, 302
  - Comatulella ... 48, 55, 294, **296**, 328; pl. 31, figs. 93, 94; pl. 32, figs. 95, 97.
- brachycirra, Comatella ... 59, 90, 92 (in key), 105, **121**, 690
- brachymera, Actinometra ... 79, 533, 546, 549
  - Antedon ... 3
  - Heliometra ... 6, 27
- brachypoda, Comactinia echinoptera f ... 383
- brasiliensis, Actinometra ... 377, 397
  - Comactinia echinoptera f ... 388
- braziliensis, Tropiometra ... 5
- braueri var. japonicus, Democrinus ... 60
- brevicirra, Antedon ... 444, 446, 447, 451
  - Bathymetra ... 13, 15
  - Colobometra (Prometra) ... 52
  - Comaster ... 411, 413 (in key), 444, 448, 451, 679; pl. 29, figs. 84–86.
  - Comatula ... 41, 174, 205, 318, 628, 631, 646, 674, 675, 676, 681

Page

- brevicirra, Prometra ... 50
- brevicuneata, Dichrometra ... 33
  - Himerometra ... 6
- brevipes, Trichometra ... 51
- brevipinna, Antedon ... 18
  - Charitometra ... 8
  - Comatula ... 17, 34
  - Pachylometra ... 34
- Brevipinna group ... 5
- breviradia, Stiremetra ... 33
  - Thalassometra ... 7
- brevis, Rhizocrinus ... 38
- briareus, Actinometra ... 492, 499, 502
  - Antedon ... 41, 492, 502
  - Comantheria ... 48, 159, 483, 484 (in key), 489, **492**, 503, 507, 520, 614, 615, 631, 663, 679, 693; pl. 57, figs. 163, 164; pl. 64, fig. 178.
  - Comanthus ... 36, 37, 493
  - Comanthus (Comantheria) ... 493
  - Comaster ... 11, 492
  - Phanogenia ... 24, 492
- briseis, Antedon ... 3, 8
  - Iridometra ... 12, 21
- brockii, Heterometra ... 32
  - Himerometra ... 6
- brunnea, Cenometra ... 32
- brunnum, Caput-Medusae ... 204, 531, 544
- Bythocrinus ... 53, 57
- Calamocrinus ... 43, 53, 57
- caledoniae, Oligometra ... 47
- callipepla, Comanthus ... 606, 615
- callipeplum, Comanthus ... 605, 614, 622, 630, 631, 663
- callista, Antedon ... 4, 8
  - Calometra ... 8, 21
- Calometra ... 8, 14, 15, 26, 49, 89
- Calometra acanthaster ... 30
  - alecto ... 44
  - bassett-smithi ... 8, 99
  - callista ... 8, 21
  - carduum ... 30, 36
  - diana ... 50
  - discoidea ... 8
  - flavopurpurea ... 8, 20
  - magnifica ... 35
  - multicolor ... 8, 20
  - propinqua ... 8, 21
  - separata ... 8, 20
  - spinosissima ... 35
  - thetis ... 8
  - versicolor ... 8, 21
- Calometridae ... 49, 50, 61, 62, 65, 70 (in key), 73 (in key), 75, 76, 110

Page
Calyptometra ------ 58
campbellianus, Bathycrinus ------ 3
capensis, Antedon ------ 9, 22, 589, 592
Capillaster ------ 36, 37, 39, 82 (in key), 85 (in key), 86, 87, 88 (in key), 90, 91, 120, 123, 138, **156**, 157, 192, 194, 207, 214, 215, 240, 244.
Capillaster asterias ------ 157, 158 (in key), **160**; pl. 13, fig. 33; pl. 82, fig. 224.
 clarki ------ 177, 189, 195, 208
 coccodistoma ------ 158 (in key), 206, **212**, 592
 gracilicirra ------ 49, 157, 158 (in key), **169**; pl. 9, fig. 27
 macrobrachius ------ 86, 157, **158**, 160, 294; pl. 8, figs. 25, 26
 mariae ------ 86, 158 (in key), **170**, 177, 207; pl. 12, fig. 32
 multiradiata ------ 37, 45, 46, 86, **117**, 157, 158 (in key), 164, 170, **173**, 209, 210, 212, 213, 214, 215, 229, 356, 397, 545, 627, 677, 683, 693; pl. 3, fig. 5; pl. 11, fig. 30; pl. 13, fig. 34; pl. 14, figs. 35, 36; pl. 81, figs. 222, 223
 multiradiata coccodistoma ------ 46, 55, 212
 var. coccodistoma ------ 212, 213, 214
 sentosa ------ 55, 64, 86, 87, 158 (in key), **160**, 169, 170, 180, 204, 205, 426, 544, 693; pl. 9, fig. 28; pl. 10, fig. 29; pl. 11, fig. 31.
 tenuicirra ------ 49, 157, 158 (in key), 170, **209**; pl. 15, fig. 37
capillastericola, Sabinella ------ 181
Capillasterinae ------ 39, 65, 69 (in key), **85**, 157, 192, 240, 294, 295, 408
Capillasterinés ------ 85
Caput-Medusae brunnum ------ 204, 531, 544
 cinereum ------ 204
caput-medusae, Encrinus ------ 59
 Pentacrinites ------ 60
carduum, Calometra ------ 30, 36
caribbea, Oligometra ------ 12, 13, 15, 32
caribbeus, Bathycrinus ------ 10, 14
carinata, Actinometra echinoptera var ------ 231, 276, 279, 280, 398
 Actinometra meridionalis var ------ 276, 283, 377, 396
 Comatula ------ 5, 22
 Perissometra ------ 60
 Tropiometra ------ 5, 9, 14, 17, 26, 45, 339, 592
carinata-discoidea, Actinometra echinoptera var ------ 276, 283, 399
carinata-pulchella, Actinometra echinoptera var ------ 125, 276, 283, 399
carinata-rubiginosa, Actinometra echinoptera var ------ 226, 232, 399
carinifera, Stiremetra ------ 52
carpenteri, Antedon ------ 8
 Bathycrinus ------ 27
 Bathymetra ------ 13, 15
 Comaster ------ 11, 416, 428, 512, 513
 Oligometra ------ 12, 32
 Phanogenia ------ 24, 36, 47, 416, 510
Carpenterocrinus ------ 21, 23, 26, 53
Carpenterocrinus mollis ------ 21
Catoptometra ------ 21, 23
Catoptometra hartlaubi ------ 21
 koehleri ------ 21
 magnifica ------ 30
 magnifica var. minor ------ 59
 ophiura ------ 44
 rubroflava ------ 21
cecropia, Platysamia ------ 42
celtica, Leptometra ------ 12, 45
Cenocrinus ------ 26, 53, 60
Cenolia ------ 57, 406, 407, 529 (in key), **530**, 649
Cenometra ------ 32, 41
Cenometra abbotti ------ 32
 bella ------ 32
 brunnea ------ 32
 delicata ------ 36
 emendatrix ------ 45, 46
 herdmani ------ 38
 insueta ------ 38
 unicornis ------ 32, 36
chadwicki, Colobometra ------ 46, 52
 Comissia ------ 52, 246 (in key), **257**, 265, 607, 637, 680; pl. 65, fig. 185
challengeri, Antedon ------ 9
chamberlaini, Eumetra ------ 30
Charitometra ------ 8, 14, 15, 20, 27, 28, 34
Charitometra aculeata ------ 8, 27
 angusticalyx ------ 8
 basicurva ------ 8
 brevipinna ------ 8
 compressa ------ 8
 distincta ------ 8, 20, 44
 flexilis ------ 8
 garrettiana ------ 8, 21
 granulifera ------ 8
 hepburniana ------ 8, 21, 27
 imbricata ------ 17
 inaequalis ------ 8, 14, 22
 incisa ------ 8, 34
 lata ------ 8, 20
 lateralis ------ 15, 58
 orion ------ 8

Page
Charitometra parvipinna ---------- 8
  patula ---------- 8
  pourtalèsi ---------- 8
  robusta ---------- 8
  sclateri ---------- 14
  smithi ---------- 30
  tuberosa ---------- 8, 27
Charitometridae ---------- 50, 58, 61, 62, 64, 65, 71 (in key), 74 (in key), 75
Charitometrinae ---------- 33, 34, 49
China Sea-Star, Double ray'd ---------- 173
chinensis perelegans, Stella ---------- 173, 203, 356
Chlorometra ---------- 34
Chlorometra aculeata ---------- 34
  garrettiana ---------- 34
  robusta ---------- 44, 58
Chondrometra ---------- 58
chuni, Rhizocrinus ---------- 38, 45
ciliata, Antedon ---------- 3, 9, 12
  Dichrometra ---------- 52
cinereum, Caput-Medusae ---------- 204
cingulatus, Metacrinus ---------- 25
clarae, Antedon ---------- 51
  Cyllometra ---------- 31
clarki, Capillaster ---------- 177, 189, 195, 208
Clarkometra ---------- 59
Clarkometra elegans ---------- 59
clemens, Antedon ---------- 20
  Himerometra ---------- 6
clio, Antedon ---------- 3, 46
  Cyclometra ---------- 46
  Heliometra ---------- 6, 21
elymene, Nanometra ---------- 51
coccodistoma, Actinometra ---------- 212, 213
  Capillaster ---------- 158 (in key), 206, **212**, 592
  Capillaster multiradiata ---------- 46, 55, 212
  Capillaster multiradiata var ---------- 212, 213, 214
  Comatula ---------- 212, 589, 592, 593
Coccometra ---------- 12, 14, 15, 28, 39, 58, 215
Coccometra hagenii ---------- 12, 292, 395
  nigrolineata ---------- 13
Colobometra ---------- 31, 41, 284
Colobometra chadwicki ---------- 46, 52
  diadema ---------- 42
  discolor ---------- 38
  perspinosa ---------- 31
  suavis ---------- 31
  vepretum ---------- 41
Colobometra (Prometra) brevicirra ---------- 52
Colobometridae ---------- 39, 41, 50, 61, 62, 65, 70 (in key), 72 (in key), 73 (in key), 75, 76, 284.
columnaris, Antedon ---------- 6
  Zenometra ---------- 6

Page
Comactinia ---------- 37, 39, 82 (in key), 293, 294, 295 (in key), 339, **374**
Comactinia echinoptera ---------- 128, 133, 231, 277, 280, 283, 301, 351, 359, **375**, 398, 399, 400, 692; pl. 42, figs. 125–128; pl. 43, figs. 129, 130; pl. 44, figs. 131–135.
  echinoptera f. brachypoda ---------- 383
    brasiliensis ---------- 388
    meridionalis ---------- 384
    var. valida ---------- 280
Comactinia meridionalis ---------- 50, 136, 277, 283, 378
Comactinia (Actinometra) ---------- 374
Comactinia (Actinometra) meridionalis ---------- 379
Comactiniinae ---------- 39, 65, 69 (in key), 70 (in key), 76, 86, 88, 157, **293**, 405, 408, 691.
Comactiniinés ---------- 293
Comantheria ---------- 41, 84 in (key), 85 (in key), 405, 406, 408, 409 (in key), 411, 465, **483**, 519, 587, 619, 663, 666, 689, 690.
Comantheria alternans ---------- 483, 484 (in key), **488**, 502
  belli ---------- 459
  briareus ---------- 48, 159, 483, 484 (in key), 489, **492**, 503, 507, 520, 614, 615, 631, 663, 679, 693; pl. 57, figs. 163, 164; pl. 64, fig. 178.
  delicata ---------- 484, 485 (in key), 502, **521**, 686, 690; pl. 62, figs. 174, 175.
  grandicalyx ---------- 484, 485 (in key), **513**, 515, 519, 520, 521; pl. 59, figs. 167, 168; pl. 60, fig. 170.
  grandicalyx var. flagellipinna ---------- 59, 515, 521
  imbricata ---------- 484, 485 (in key), **515**, 519, 529, 681; pl. 29, fig. 87; pl. 62, fig. 173.
  intermedia ---------- 58, 484 (in key), 506, **508**, 529; pl. 60, fig. 169; pl. 61, figs. 171, 172; pl. 65, fig. 182
  magnifica ---------- 493
  perplexum ---------- 484 (in key), **506**
  polycnemis ---------- 429, 483, 484 (in key), **485**, 489, 490; pl. 56, fig. 162.
  rotula ---------- 49, 484 (in key), 486, **503**, 683; pl. 58, fig. 165
  taviana ---------- 484 (in key), **510**; pl. 63, figs. 176, 177
  weberi ---------- 49, 484 (in key), **505**, 507, 508; pl. 58, fig. 166
  sp ---------- 686, 687

Page

Comanthina ---- 41, 51, 84 (in key), 405, 406, 407, 408, 409 (in key), 411, **457**, 465, 483, 576, 666
Comanthina belli ---- 48, 424, 429, 457, **458**, 468, 514, 529; pl. 53, fig. 157; pl. 73, fig. 199.
  schlegelii ---- 87, 419, 424, 427, 457, 458 (in key), 464, **466**, 544, 577, 693; pl. 53, fig. 158; pl. 54, fig. 159; pl. 55, figs. 160, 161; pl. 64, fig. 180.
comanthipinna, Comanthus parvicirra f ---- 59, 406, 407, 636, 649, 664, 665
  Comanthus (Vania) parvicirra f ---- 636, 683
Comanthoides ---- 81 (in key), 83 (in key), 84 (in key), 87, 88, 89 (in key); **240**, 276.
Comanthoides spanoschistum ---- **241**, 246 (in key), 251; pl. 21, figs. 52–57; pl. 22, fig. 58; pl. 23, fig. 63.
Comanthus ---- 30, 37, 39, 41, 46, 49, 83 (in key), 84 (in key), 85 (in key), 87, 194, 240, 244, 245, 400, 405, 406, 407, 408, 409 (in key), 436, 450, 457, 465, 483, 484, **527**, 529 (in key), 593, **603**, 663, 665, 691.
Comanthus alternans ---- 30, 36, 489, 492
  annulata ---- 599, 605, 643, 682, 683
  annulata var. xantha ---- 606
  annulatum ---- 602, 605
  annulatum xanthum ---- 606
    var. xanthum ---- 606, 615, 630, 631
  annulatus ---- 606
  belli ---- 458
  benhami ---- 59, 529, 531 (in key), 584, 586, **587**, 588; pl. 74, fig. 202.
  bennetti ---- 87, 168, 204, 405, 426, 481, 519, 529, 530 (in key), **531**, 553, 555, 556, 567; pl. 66, figs. 186, 187; pl. 67, fig. 188; pl. 68, fig. 189; pl. 82, fig. 225.
  briareus ---- 36, 37, 493
  callipepla ---- 606, 615
  callipeplum ---- 605, 614, 622, 630, 631, 663
  crassicirra ---- 49, 534, 539, 550
  cumingii ---- 31, 342, 359
  decameros ---- 29, 30, 37, 359, 401
  divaricata ---- 30, 492
  duplex ---- 30, 36, 467, 482
  grandicalyx ---- 513
  imbricata ---- 515
  intricata ---- 29, 30, 37, 51, 604, 618, 629, 681
Comanthus japonica ---- 87, 484, 529, 530 (in key), 539, 550, 554, 561, **564**, 576, 577, 584, 585, 586; pl. 71, fig. 195; pl. 72, figs. 196–198; pl. 73, fig. 201; pl. 82, fig. 227.
  japonicus ---- 565
  luteofusca ---- 594, 603
  luteofuscum ---- 594, 597, 599, 602
  magnifica ---- 492
  nobilis ---- 30, 36, 467, 482
  novaezealandiae ---- 59, 529, 531 (in key), 584, 586, **588**, 596
  parvicirra ---- 47, 192, 205, 207, 209, 269, 270, 318, 405, 406, 408, 411, 450, 451, 455, 456, 520, 528, 570, 594, 599, 601, 602, 603 (in key), 605, 606, 607, 610, 611, 620, 627, 628, 629, 630, **631**, 679, 693; pl. 29, fig. 88; pl. 65, fig. 184; pl. 73, fig. 200; pl. 78, figs. 209, 210; pl. 79, figs. 211–214; pl. 80, figs. 215–218; pl. 81, fig. 221.
  (?parvicirra) ---- 267
  parvicirra f. comanthipinna ---- 59, 406, 407, 636, 649, 664, 665
    comasteripinna ---- 59, 406, 503, 636, 648, 650, 651, 664, 665, 684
    vaniipinna ---- 60, 650, 651, 684
    vanipinna ---- 636, 664, 665
  parvicirrum ---- 602, 636
  pinguis ---- 87, 405, 468, 484, 529, 530 (in key), **553**, 565, 566, 570, 572, 574, 577, 584; pl. 70, figs. 192, 193; pl. 71, fig. 194.
  plectrophorum ---- 59, 459, 529, 530 (in key), **550**; pl. 23, fig. 62; pl. 69, figs. 190, 191.
  polycnemis ---- 36, 429, 485, 489
  regalis ---- 467
  robustipinna ---- 549, 553
  rotalaria ---- 30, 36, 37, 456, 520, 604, 635, 680
  rotula ---- 503
  samoana ---- 411, 529, 531 (in key), **593**, 599, 601, 602, 628, 639, 640, 648, 649, 658, 662, 677, 679, 681, 682; pl. 78, fig. 208; pl. 81, figs. 219, 220.
  samoanum ---- 594, 602
  schlegelii ---- 459, 465, 467
  serrata ---- 452
  solaster ---- 508, 529, 530 (in key), 561, 565, 566, 572, **576**, 584; pl. 20, fig. 51

Page

Comanthus solaster f. multicirra 565
spanoschistum 241, 250, 251, 253, 587
tasmaniae 59, 241, 244, 529, 531 (in key), 584, **586**, 588
timorensis 159, 406, 407, 408, 451, 483, 484, 503, 528, 602, **603**, 637, 641, 642, 643, 656, 662, 663, 664, 665, 666, 674, 675, 677, 678, 679, 680, 681, 682, 683, 693, 694; pl. 64, fig. 181; pl. 75, fig. 204; pl. 76, fig. 205; pl. 77, figs. 206, 207.
trichoptera 87, 108, 468, 529, 531 (in key), 553, 561, 572, **579**, 586, 588, 589, 591, 592, 682: pl. 3, fig. 4; pl. 74, fig. 203.
trichoptera benhami 57, 587
valida 605
wahlbergi 589
wahlbergii 46,213, 529, 531 (in key), 581, 584, 585, **588**, 592, 677; pl. 65, fig. 183.
weberi 505
sp 636
Comanthus (Bennettia) bennetti 534
japonica 565
pinguis 554
samoana 594
solaster 576
trichoptera 48, 565, 580, 586
wahlbergii 45, 589, 681
Comanthus (Cenolia) bennetti 534
samoana 594
trichoptera 57, 580
wahlbergii 589
Comanthus (Comantheria) 483
(Comantheria) briareus 493
(Comanthina) 457
(Comanthina) nobilis 467
schlegelii 467
(Comanthus) 528
(Comanthus) annulata 605, 630
bennetti 533
parvicirra 406, 529, 635
pinguis 38, 554, 563
rotalaria 41, 455, 515, 593, 602, 604, 629, 635, 681
samoana 38, 593
solaster 576
trichoptera 580
valida 604, 629, 681
sp 636
Comanthus (Validia) 603
(Validia) parvicirra 45, 269, 636
(?) parvicirra 267, 681

Page

Comanthus (Vania) 603, 665
(Vania) annulata 48, 55, 605, 629, 631
parvicirra 55, 177, 636
parvicirra f. comanthipinna 636, 683
comasteripinna 636, 683
vaniipinna 684
Comaster 1, 2, 10, 11, 14, 15, 25, 26, 30, 35, 36, 37, 47, 51,78, 79, 83 (in key), 84 (in key), 89, 122, 156, 207, 214, 244, 336, 374, 405, 406, 407, 408, **409**, 430, 435, 450, 457, 458, 464, 465, 483, 512, 523, 527, 545, 546, 547, 548, 549, 648, 663, 665, 666, 680, 688, 689, 690.
Comaster alata 11, 125
alternans 11, 489
belli 11, 430, 458
bennetti 11, 514, 533
borneensis 11, 24, 25, 176, 207
brevicirra 411, 413 (in key), **444**, 448, 451, 679; pl. 29, figs. 84–86.
briareus 11, 492
carpenteri 11, 416, 428, 512, 513
coppingeri 11, 24, 25, 30, 37, 176, 207, 208, 249, 253
delicata 521
delicata grandis 521
var. grandis 59, 521
discoidea 11, 24, 25, 232
distincta 413 (in key), 427, 444, 446, 447, **448**, 456, 677; pl. 52, fig. 153
divaricata 11, 492
duplex 11, 467
echinoptera 11, 377
elongata 11
fimbriata 11, 24, 25, 30, 176, 207
fruticosus 39, 44, 412 (in key), 429, 437, 439, **440**, 442, 443; pl. 48, fig. 145; pl. 49, figs. 146, 147.
gracilis 11, 412 (in key), 428, **430**, 435; pl. 47, figs. 143, 144.
grandicalyx 11, 513
(?) horridus 44, 254
imbricata 20, 515, 521
iowensis 11, 24, 25, 219
japonica 11, 20, 564, 575
lineata 11, 24, 25, 226
littoralis 11, 604
macrobrachius 11, 158
maculata 11, 112
magnifica 11, 492
mariae 11, 21, 24, 25, 170
meridionalis 11, 377

Page

Comaster minima 405, 412 (in key), **435**; pl. 52, fig. 156
  minimus 435
  multibrachiata 412 (in key), **437**, 440, 693; pl. 46, fig. 142
  multifida 168, 177, 192, 209, 406, 411, 412 (in key), 413, 431, 433, 434, 435, 451, 510, 636, 642, 665, 666, 683; pl. 46, figs. 140, 141.
  multiradiata 11, 21, 24, 25, 36, 170, 176, 207
  multiradiatus 79, 413, 532, 545, 546, 548
  nobilis 11, 467
  novae-guineae 39, 440, 442, 443
  novaeguinea 417
  novaeguineae 11, 416, 417, 427, 430, 441
  orientalis 11, 635
  parvicirra 11, 20, 451, 455, 635, 680
  parvus 38, 411, 444, 447, 451
  peronii 11, 533
  philippinensis 440, 442
  pulcher 49, 413 (in key), **443**, 448; pl. 50, figs. 148, 149
  quadrata 11
  imbricata 20, 515, 521
  regalis 11, 467
  robustipinna 11, 20, 553
  rotalaria 11, 635
  rubiginosa 11, 226
  schlegelii 11, 467
  schönovi 412, **443**; pl. 64, fig. 179
  (?) scitulus 44, 274
  sentosa 11, 24, 25, 30, 36, 161
  serrata 21, 413 (in key), 448, **451**, 680, 686, 690; pl. 52, fig. 154
  serratus 447
  sibogae 49, 413 (in key); **442**; pl. 51, fig. 152
  solaster 11, 21, 576
  stelligera 11, 99
  taviana 47, 429, 430, 510, 513
  tenella 412, 413 (in key), 448, **455**, 456, 663, 681; pl. 51, figs. 150, 151
  trichoptera 11, 80, 580
  typica 11, 37, 48, 406, 416, 429, 430, 434, 442, 459, 465, 503, 504, 505, 636, 642, 665, 666, 682
  typica f. minor 503
  valida 11, 604
  variabilis 11, 416
  sp 456
Comaster (Neocomatella) alata 18

Page

comaster, Thaumatometra 12, 13, 15
Comasterida 61, 65, 69 (in key), 70 (in key), **76**
Comasteridae 14, 15, 26, 39, 49, 61, 62, 64, 65, 69 (in key), 72 (in key), 75, **76**, 79, 80, 157, 181, 379, 395, 396, 397, 398, 694.
Comastéridés 77
Comasterinae 65, 69 (in key), 76, 86, 87, **157**, 194, 240, **404**, 408, 666, 689
Comastérinés 404
comasteripinna, Comanthus parvicirra f. 59, 406, 503, 636, 648, 650, 651, 664, 665, 684
  Comanthus (Vania) parvicirra f. 636, 683
Comastrocrinus 52, 53, 60
comata, Zygometra 49
Comatella 30, 37, 39, 83 (in key), 86, 88 (in key), **89**, 123, 157, 192, 194, 215, 244, 294, 308, 411, 436, 523, 688, 690
Comatella alata 125
  brachycirra 59, 90, 92 (iu key), 105, **121**, 690
  decora 52, 91, 92 (in key), 113, **119**
  maculata 45. 46, 92 (in key), **105**, **112**, 194, 685; pl. 20, fig. 50
  nigra 31, 36, 64, 90, 91 (in key), **92**, 162; pl. 1, fig. 1; pl. 2, fig. 2; pl. 3, fig. 3.
  pulchella 125
  stelligera 88, 91, 92 (in key), 94, 95, 97, 98, 113, 117, 294, 685; pl. 4, figs. 6–9
  sp 684
  sp. juv 684
Comatilia 37, 39, 61, 78, 82 (in key), 86, 87, 88, 89 (in key), **284**, 288, 289, 400, 690
Comatilia iridometriformis 36, 37, 64, 285; pl. 30, figs. 89–92
Comatonia 57, 61, 63, 64, 78, 82 (in key), 87, 88, 89 (in key), **288**, 400
Comatonia cristata 231, 288, **289**, 399; pl. 6, figs. 17–20
Comatula 1, 2, 4, 5, 10, 14, 15, 23, 25, 26, 30, 37, 39, 78, 79, 81, 82 (in Key), 83 (in key), 85 (in key), 89, 156, 293, 294, 295 (in key), **302**, 308 (in key), 320, 336, 339, 374, 375, 409, 425, 436, 527, 680
Comatula actinodes 691
  adeonae 23, 47
  barbata 340
  bennetti 79, 532, 545

Page

- Comatula brachiolata 48, 79, 80, 296, 301, 302
  - brevicirra 41, 174, 205, 318, 628, 631, 646, 674, 675, 676, 681
  - brevipinna 17, 34
  - carinata 5, 22
  - coccodistoma 212, 589, 592, 593
  - cotalaria 311
  - cratera 294, **320**, 338
  - cumingii 79, 80, 295, 340, 344, 357, 359, 360
  - distincta 10, 24, 448
  - echinoptera 375, 394
  - elongata 22, 680
  - etheridgei 49, 310, 312, 319
  - etheridgi 310
  - fimbriata 36, 37, 79, 80, 174, 182, 191, 192, 204, 205, 208, 397
  - hagenii 12
  - helianthus 22, 41, 680, 681
  - holmesi 376, 394
  - inserta 691
  - japonica 79, 564, 574
  - macronema 7, 10, 47
  - mariae 4, 170
  - meridionalis 80, 376
  - mertensi 41, 632, 659, 675, 677, 678, 681
  - micraster 38, 294, 320 (in key), 350, **373**; pl. 41, figs. 112, 113, 115–124
  - moniliformis 691
  - monilis 691
  - multibrachiata 10, 24, 437
  - multifida 79, 161, 168, 414, 426, 532
  - multiradiata 1, 10, 11, 23, 25, 35, 37, 78, 160, 168, 169, 175, 204, 205, 413, 425, 428, 429, 512, 513, 531, 539, 544, 545, 546, 549.
  - multistriata 176
  - nigra 92
  - notata 10, 24, 99
  - novae-Guineae 79, 414, 426, 466
  - orientalis 4, 41, 635, 680, 681
  - parvicirra 592, 631, 674
  - paucicirra 10, 21, 24, 119, 121, 294, 310
  - pectinata 10, 24, 30, 36, 39, 41, 203, 250, 274, 294, 295, 308, 320 (in key), 323, 330, 331, 335, 337, 338, **339**, 359, 360, 361, 362, 363, 365, 366, 371, 372, 375, 396, 397, 398, 661, 675, 679, 692; pl. 20, fig. 49; pl. 33, fig. 100; pl. 34, fig. 101; pl. 35, fig. 102; pl. 36, fig. 103; pl. 37, fig. 104; pl. 38, figs. 105–107.
  - pectinata affinis 352
    - hamata 352
    - pectinata 352

Page

- Comatula pectinata var. purpurea 361
  - picta 46
  - polyactinia 691
  - polyactinis 691
  - polymorpha 632
  - purpurea 48, 55, 294, 320 (in key), 323, 335, 337, 343, 348, 356, **360**, 372, 626, 658; pl. 39, figs. 108, 109; pl. 40, fig. 111; pl. 41, fig. 114.
  - rosacea 694
  - rosea 296, 301, 302
  - rosularis 342
  - rotalaria 30, 41, 47, 49, 79, 80, 109, 205, 294, 307, **309**, 317, 318, 319, 322, 344, 439, 628, 629, 675, 676, 679, 681, 682, 693; pl. 32, fig. 98.
  - rotularia 309
  - rotularis 309
  - serrata 4, 10, 451
  - simplex 41, 361, 370, 634, 644, 680, 681
  - solaris 10, 23, 24, 37, 78, 80, 81, 192, 205, 294, 300, 314, 320 (in key), 321, 322, **323**, 339, 343, 357, 370, 396, 398, 675, 691, 693; pl. 33, fig. 99.
  - solaris gracilior 335
    - var. hamata 339
    - solaris 335, 339
    - var. solaris 320
  - solaster 4, 576
  - tenuicirra 49, 294, 320 (in key), 361, **372**; pl. 39, fig. 110
  - timorensis 79, 592, 603, 627
  - trichoptera 79, 579, 585
  - triqueta 691
  - wahlbergi 589
  - sp 92, 310, 376, 394, 414, 437, 448, 693
- Comatula (Actinometra) 156, 307, 308, 527
  - (Actinometra) borneensis 175, 183, 205
  - (Actinometra?) hamata 337, 338, 341, 357
    - rotalaria 309
  - (Actinometra) solaris 324, 335, 357
    - solaris var 340
    - wahlbergii 589
- Comatula (Alecto) 156, 374, 527
  - (Alecto) echinoptera 376, 394
    - fimbriata 174, 204, 205
    - multiradiata 161, 174, 175, 205, 532
    - parvicirra 631, 674
- Comatula (Comatula) 320
  - (Comatula) micraster 373
    - pectinata 342

Page
Comatula (Comatula) purpurea 361
solaris 326
solaris var. hamata 326
solaris 326
Comatula (Validia) 308
(Validia) etheridgei 311, 319
rotalaria 311, 319
Comatula-Art, Philippinische 632
Comatuladae 81
Comatulae 5, 694
Comatule 150, 302
Comatulella 48, 82 (in key), 293, 294, 295
Comatulella brachiolata 48, 55, 294, **296**, 328; pl. 31, figs. 93, 94; pl. 32, figs. 95–97.
Comatules 305
Comatulida 14, 15, 43, 65, **68**, 75
Comatulida Innatantes 39
Macrophreata 39, 75
Oliogphreata 39, 74, 75
Comatulidae 5, 81
Comatulides 82 (in key), 293, 294, 295 (in key), **400**
Comatulides australis 401 (in key), **403**; pl. 45, figs. 138, 139
decameros 359, **401**, 403, 692; pl. 45, figs. 136, 137
Comatulids 53
Cominia 37, 39, 294, 400
Cominia australis 49, 403
decameros 401
Comissia 37, 39, 81 (in key), 87, 88, 89 (in key), 240, **244**, 295, 375, 587, 682, 690, 692
Comissia chadwicki 52, 246 (in key), **257**, 265, 607, 637, 680; pl. 65, fig. 185
dumetum 44, 248, 249
gracilipes 49, 247 (in key), **265**, 267; pl. 28, figs. 75, 76
hartmeyeri 52, 247 (in key), **267**, 681, 683; pl. 28, figs, 78, 79; pl. 29, figs. 80–82
hispida 44, 246 (in key), 257, **258**, 260, 261, 265; pl. 29, fig. 83
horridus 246 (in key), **254**; pl. 24, fig. 68
ignota 46, 247 (in key), **269**, 681
ignota minuta 270
var. minuta 59, 270
littoralis 49, 246 (in key), **256**; pl. 26, figs. 71, 72
lütkeni 37, 208, 246 (in key), **249**, 255; pl. 24, figs. 66, 67
magnifica 246 (in key), **247**, 249, 685
minuta 247 (in key), **270**, 690

Page
Comissia parvula 49, 246 (in key), 259, 261, **262**, 266, 267; pl. 28, fig. 77
pectinifer 46, 246 (in key), **255**; pl. 25, figs. 69, 70
peregrina 246 (in key), **248**; pl. 24, fig. 65
peregrina magnifica 247
var. magnifica 59, 247
scitulus 246 (in key), **274**
spanoschistum 59, 241
spinosissima 49, 246 (in key), **259**, 265; pl. 27, figs. 73, 74
sp 257, 259, 684
complanatus, Bathycrinus 5, 27
compressa, Antedon 14
Charitometra 8
Parametra 33, 36
Thalassometra 31
Compsometra 12, 14, 15, 26, 39, 58
Compsometra gracilipes 51
incommoda 48, 59
iris 51
lacertosa 43
longicirra 51
lovéni 12, 108
parviflora 51, 87
serrata 12, 20, 574
compta, Heterometra 38
conaminis, Neometra 55
concinna, Crinometra 38
Eumorphometra 56
Oligometra 52
congesta, Psathyrometra 15
conifer, Atelecrinus 15
Rhizocrinus 38
conifera, Stenometra 33
coppingeri, Actinometra 36, 37, 175, 181, 190, 206, 207, 208, 397
Comaster 11, 24, 25, 30, 37, 176, 207, 208, 249, 253
coralloides, Encrinus 23
coronata, Stephanometra 38
Cosmiometra 34, 642
Cosmiometra crassicirra 34
dasybrachia 59
delicata 34
gardineri 46
helene 50
komachi 34
philippinensis 44
woodmasoni 34
costatus, Solanocrinus 546
cotalaria, Comatula 311

Page
Cotyloderma 54
Cotylometra 57, 284
Craspedometra 32, 39
Craspedometra acuticirra 32, 157
aliena 38
amboinae 52
ater 46
australis 32
bipartipinna 32
ludovici 32
madagascarensis 46
crassa, Pachylometra 50
crassicirra, Comanthus 49, 534, 539, 550
Cosmiometra 34
Thalassometra 15
crassipinna, Antedon 6
Himerometra 6, 21, 32
cratera, Comatula 294, **320**, 338
Crinoidea 40
Crinometra 17, 34, 62
Crinometra concinna 38
gemmata 38
granulifera 142
insculpta 38
margaritacea 38
pulchra 38
crispa, Iridometra 12, 13, 15, 58
cristata, Actinometra 57, 231, 289, 399
Asterometra 44
Comatonia 231, 288, **289**, 399; pl. 6, figs. 17–20
Stenometra 44
Crossometra 58
Crotalometra 35, 36
Crotalometra annandalei 38
cupedata 36
flava 45
infelix 44
porrecta 153
propinqua 44
rustica 35
sentifera 38
sulcata 50
vera 50
cumingi, Actinometra 342, 359, 634, 677
cumingii, Actinometra 341, 358, 395, 397, 634, 644, 677, 682, 692
Antedon 342, 359
Comanthus 31, 342, 359
Comatula 79, 80, 295, 340, 344, 357, 359, 360
cupuliferus, Antedon 30
cyaneus, Metacrinus 59

Page
Cyathidium 54
Cyclometra 46, 57
Cyclometra clio 46
flavescens 46
Cyllometra 7, 14, 15, 31, 41, 284
Cyllometra albopurpurea 9, 15, 20, 31
anomala 29, 31
belli 7, 9, 23
clarae 31
gracilis 50
impinnata 7, 31
informis 7, 31, 36
manca 7, 9, 31, 36
mollis 35
perspinosa 7
pulchella 59
ruber 7
soluta 38
studeri 36, 37
suavis 30, 31
taprobanes 38
tigrina 7, 21, 31
sp 36
cysticolum, Myzostomum 276
Cystoidea 40
Dadocrinus 53
Daidalometra 57
dasybrachia, Cosmiometra 59
decameros, Comanthus 29, 30, 37, 359, 401
Comatulides 359, **401**, 403, 692; pl. 45, figs. 136, 137
Cominia 401
Decametra 46, 284
Decametra alaudae 46
arabica 52
informis 46
modica 46
möbiusi 46
mollis 50
mylitta 50
taprobanes 46
Decametrocrinidae 5
Decametrocrinus 2, 5, 13, 14, 15, 19, 20
Decametrocrinus abyssorum 51
borealis 3, 21
rugosus 15
decora, Comatella 52, 91, 92 (in key), 113, **119**
decorus, Isocrinus 10, 23, 25, 26
Encrinus (Isocrinus) 35
Isocrinus (Isocrinus) 16, 26
Neocrinus 80
Pentacrinus 16, 60
defecta, Hypalometra 292

Page

- delicata, Cenometra 36
  - Comantheria 484, 485 (in key), 502, **521**, 686, 690; pl. 62, figs. 174, 175
  - Comaster 521
  - Cosmiometra 34
  - Phanogenia 36, 521
  - Thalassometra 15
  - Trichometra 47, 51
- delicata grandis, Comaster 521
  - var. grandis, Comaster 59, 521
- delicatissima, Antedon 4
  - Himerometra 6, 21
- Democrinus 53, 57
- Democrinus braueri var. japonicus 60
- dentata, Alectro 12, 394
  - Antedon 9
  - Hathrometra 12
  - Stenometra 59
- denticulata, Homalometra 157
  - Nanometra 5
- diadema, Antedon 4
  - Colobometra 42
  - Stenometra 33
  - Thalassometra 7, 21
- diana, Calometra 50
- Dichrometra 33, 39, 46, 53, 194
- Dichrometra aranea 35
  - articulata 33
  - bimaculata 33
  - brevicuneata 33
  - ciliata 52
  - dofleini 58
  - elongata 33
  - flagellata 33, 45
  - flagellata var. afra 51
  - gracilipes 33
  - grandis 33
  - gyges 33, 51
  - heliaster 33
  - klunzingeri 33, 45
  - marginata 33
  - occulta 33
  - okelli 33
  - palmata 33, 37, 45, 52
  - protectus 33, 37, 45, 52
  - regalis 33
  - reginae 33
  - subcarinata 33
  - subtilis 33
  - tenera 33, 48
- Didontometra 59
- Didontometra bocki 59
- difficilis, Actinometra 49, 154, 155
  - Palaeocomatella 118, **154**; pl. 7, figs. 23, 24

Page

- diomedeae, Antedon 4, 7
  - Pentametrocrinus 21, 30
  - Perometra 7, 20
- Diplocrinus 60
- discoidea, Actinometer 232
  - Actinometra 206, 207, 232, 235, 239
  - Actinometra echinoptera var 219, 224, 232, 235, 239, 280, 399
  - Amphimetra 41, 48, 55
  - Antedon 4, 8
  - Calometra 8
  - Comaster 11, 24, 25, 232
  - Himerometra 30
  - Nemaster 172, 215 (in key), 216, 223, 226, **232**, 280, 399, 400; pl. 19, figs. 46, 47; pl. 20, fig. 48.
- discolor, Colobometra 38
- dissimilis, Actinometra 466, 477, 481, 482
- distincta, Actinometra 448, 451
  - Antedon 34
  - Charitometra 8, 20, 44
  - Comaster 413 (in key), 427, 444, 446, 447, **448**, 456, 677; pl. 52, fig. 153
  - Comatula 10, 24, 448
  - Pachylometra 18, 34
  - Phanogenia 448
- divaricata, Actinometra 492, 497, 499, 502, 503
  - Comanthus 30, 492
  - Comaster 11, 492
  - Phanogenia 24, 492
- döderleini, Himerometra 6, 21
- dofleini, Dichrometra 58
- Dolichocrinus 53
- dorcadis, Ptilometra 35, 37, 47, 49
- Dorometra 58, 285
- dorsata, Stenometra 41
- Double ray'd China Sea-Star 173
- dübeni, Antedon 9
- dübenii, Antedon 14, 56
- dumetum, Comissia 44, 248, 249
- duplex, Actinometra 466, 472, 473, 481, 482, 493
  - Antedon 34
  - Comanthus 30, 36, 467, 482
  - Comaster 11, 467
  - Phanogenia 24, 467
  - Thalassometra 7
- echinata, Thalassometra 7, 33
- Echinodermata 40
- Echinodermata Astroradiata 40
  - Heteroradiata 40
- Echinoidea 40

Page
echinophora, Alecto 376
echinoptera, Actinometra 142, 229, 231, 238, 294, 295, 342, 397, 398
Alecto 37, 79, 80, 376, 382, 394, 395
Comactinia 128, 133, 231, 277, 280, 283, 301, 351, 359, 375, 398, 399, 400, 692; pl. 42, figs. 125–128; pl. 43, figs. 129, 130; pl. 44, figs. 131–135.
Comaster 11, 377
Comatula 375, 394
Comatula (Alecto) 376, 394
Phanogenia 24, 377
echinoptera var. alata, Actinometra 280, 377
aplanata, Actinometra 125, 400
f. brachypoda, Comactinia 383
brasiliensis, Comactinia 388
var. carinata, Actinometra 231, 276, 279, 280, 398
carinata-discoidea, Actinometra 276, 283, 399
carinata-pulchella, Actinometra 125, 276, 283, 399
carinata - rubiginosa, Actinometra 226, 232, 399
discoidea, Actinometra 219, 224, 232, 235, 239, 280, 399
echinoptera, Actinometra 378, 381, 398
lineata, Actinometra 280
(?) lineata, Actinometra 219, 226, 232, 399
f. meridionalis, Comactinia 384, 388
var. meridionalis, Actinometra 128, 231, 277, 280, 283, 326, 339, 378, 381, 382, 383, 385, 398.
meridionalis-carinata, Actinometra 129, 277, 280, 283, 378, 398
meridionalis - pulchella, Actinometra 125, 130, 399
meridionalis-rubiginosa, Actinometra 226, 229, 232, 378, 398
meridionalis - valida, Actinometra 378, 382, 383, 398
multicirra, Actinometra 219, 224, 400
pulchella, Actinometra 125, 127, 128, 136, 137, 145, 146, 150, 280, 378, 379, 399.
pulchella subvar. alata, Actinometra 127, 134, 136, 137, 143, 145, 146, 147, 399
planata, Actinometra 125, 127, 128, 131, 133, 134, 135, 136, 137, 145, 399.

Page
echinoptera var. pulchella subvar. pulchella, Actinometra 399
rubiginosa, Actinometra 226, 232, 280, 379, 398
rubiginosa-discoidea, Actinometra 232, 238, 239, 400
valida, Actinometra 280, 378, 381, 382, 383, 398
valida - meridionalis, Actinometra 379, 381, 400
Echinoptera group 2, 80, 88, 231, 294, 359, 397
Echinothuridae 42
echinus, Himerometra 30
Stephanometra 32
Edriocrinus 43
electrae, Oligometra serripinna var 46
elegans, Antedon 37
Clarkometra 59
Zygometra 5, 31, 37, 48, 49, 55
Elegans group 2, 4, 5
elongata, Actinometra 22, 406, 634, 640, 645, 665, 676, 678, 679, 680, 681
Alecto 680
Comaster 11
Comatula 22, 680
Dichrometra 33
Himerometra 6
Perometra 30
Phanogenia 24
elongata var., Actinometra 634
emendatrix, Antedon 46
Cenometra 45, 46
Himerometra 6
Encrinites milleri 60
Encrinus 23, 27, 35
Encrinus asteria 35
australis 49
boltenii 35
caput-medusae 59
coralloides 23
milleri 11, 60
mylii 35
ouifer 35
parrae 11, 16, 26, 60
radiatus 35
Encrinus (Encrinus) asteria 35
(Isocrinus) blakei 35
decorus 35
encrinus, Tropiometra 46
Endoxocrinus 16, 23, 25, 26, 27, 53, 60
Endoxocrinus alternicirrus 16, 23, 26, 36
parrae 16, 23, 26
sibogae 16, 26
wyville-thomsoni 16, 23, 26
wyvillethomsoni 45

Page
ensifer, Himerometra 29
ensiformis, Amphimetra 32
Epimetra 44, 284
Epimetra nympha 44
equatorialis, Bathycrinus 10, 14
erinacea, Antedon 33, 53
  Himerometra 6
erythrizon, Antedon 3
  Psathyrometra 6
Erythrometra 12, 14, 15, 39, 58, 284
Erythrometra ruber 12, 20
Eschrichti group 2, 4, 6
eschrichti var. magellanica, Antedon 22
eschrichtii, Heliometra 6, 17, 27
eschrichtii maxima, Antedon 3, 4
etheridgei, Comatula 49, 310, 312, 319
  Comatula (Validia) 311, 319
etheridgi, Comatula 310
Euantedon 58
Euantedon sinensis 51
Eudesicrinus 54
Eudiocrinidae 5, 15, 16, 65, 70 (in key), 71 (in key), 75, 157
Eudiocrinus 1, 2, 3, 5, 13, 14, 15, 19
Eudiocrinus atlanticus 19
  gracilis 52
  gracilis var. pulchellus 59
  granulatus 13, 19
  indivisus 13, 16, 19
  japonicus 3, 16, 19, 20
  junceus 49, 157
  lovéni 59
  minor 35
  ornatus 35
  pinnatus 49
  semperi 19
  serripinna 30
  tuberculatus 3, 19
  varians 3, 19
  variegatus 13, 19, 20
  venustulus 49
Eugeniacrinidae 54
Eugeniacrinus 54
Eumetra 30, 39, 58, 63
Eumetra chamberlaini 30
  indica 35
Eumorphometra 56, 58
Eumorphometra concinna 56
eupedata, Crotalometra 36
europaea, Neocomatella 55, 124 (in key), 125, 150
exigua, Antedon 9
  Thaumatometra 12
explicata, Trichometra 30, 58

Page
exquisita, Iridometra 36
Fariometra 58
fieldi, Antedon 22
fimbriata, Actinometra 175, 177, 180, 206, 208, 212, 213
  Alecto 174
  Comaster 11, 24, 25, 30, 176, 207
  Comatula 36, 37, 79, 80, 174, 182, 191, 192, 204, 205, 208, 397
  Comatula (Alecto) 174, 204, 205
Fimbriata group 2, 81, 88, 207, 239, 397
fimbriatus, Antedon 175
finschii, Antedon 33
  Himerometra 6
fisheri, Parametra 33
flagellata, Alecto 53
  Dichrometra 33, 45
  Himerometra 6
flagellata var. afra, Dichrometra 51
flagellifera, Mastigometra 29
flagellipinna, Comantheria grandicalyx var 59, 515, 521
  Thalassometra 15
flava, Antedon 14, 34
  Crotalometra 45
  Thalassometra 14, 27
flavescens, Cyclometra 46
flavopurpurea, Antedon 4, 52
  Calometra 8, 20
flexilis, Antedon 58
  Charitometra 8
  Pachylometra 34
flora, Amphimetra 55
Florometra 55, 57, 58
Florometra magellanica 55
fluctuans, Antedon 37
  Zygometra 49
formosa, Amphimetra 41
fossilis, Pentacrinites 23
fragilis, Antedon 3, 6
  Pachylometra 50, 58
  Psathyrometra 6, 20
fruticosus, Comaster 39, 44, 412 (in key), 429, 437, 439, **440**, 442, 443; pl. 48, fig. 145; pl. 49, figs. 146, 147.
fruticulosum, Lithothamnion 622, 666
fusca, Actinometra 79, 112, 117
Gammarocrinus 54
Ganymeda pulchella 142
gardineri, Cosmiometra 46
garrettiana, Antedon 4, 34
  Charitometra 8, 21
  Chlorometra 34
gemmata, Crinometra 38

Page
Gephyrocrinus 43, 53, 57
Gephyrocrinus grimaldii 45
Gephyrometra 52
gigantea, Thalassometra 15, 27, 33, 58
glabra, Heliometra 6, 9
glacialis, Heliometra 27, 28, 52, 95, 338, 423, 693
glacialis biarticulata, Heliometra 29
  var. maxima, Heliometra 44
Glyptometra 34
Glyptometra lata 34
  lateralis 34
  timorensis 50
  tuberosa 34, 36
Goldfussia 527, 549
gorgonia, Antedon 22
  Neometra 55
gracilicirra, Capillaster .... 49, 157, 158 (in key), **169**; pl. 9, fig. 27
  Oligometra 30, 32, 57
gracilicirra ornata, Oligometra 44
gracilior, Comatula solaris 335
gracilipes, Comissia .... 49, 247 (in key), **265**, 267; pl. 28, figs. 75, 76
  Compsometra 51
  Dichrometra 33
  Himerometra 30
gracilis, Actinometra 175, 205, 207, 430, 605
  Antedon 9
  Bathycrinus 45
  Comaster .... 11, 412 (in key), 428, **430**, 435; pl. 47, figs. 143, 144
  Cyllometra 50
  Eudiocrinus 52
  Iridometra 51
  Metacrinus batheri var 52
  Phanogenia 24, 431
gracilis var. pulchellus, Eudiocrinus 59
gracillima, Psathyrometra 38
grandicalyx, Actinometra 502, 513, 533, 549
  Comantheria .... 484, 485 (in key), 513, 519, 520, 521; pl. 59, figs. 167, 168; pl. 60, fig. 170.
  Comanthus 513
  Comaster 11, 513
  Phanogenia 24, 513
grandicalyx var. flagellipinna, Comantheria 59, 515, 521
grandis, Comaster delicata 521
  Comaster delicata var 59, 521
  Dichrometra 33
  Himerometra 29, 53
  Nemaster .... 37, 215 (in key), **216**, 219, 226, 357; pl. 16, fig. 38; pl. 17, fig. 39.
granulatus, Eudiocrinus 13, 19

Page
granulifera, Antedon 17, 18, 142
  Charitometra 8
  Crinometra 142
Granulifera group 2, 5, 7, 8, 22
gravieri, Heterometra 46, 47
grimaldii, Gephyrocrinus 45
group, Acoela 2, 4, 8
  Basicurva 2, 4, 5, 7, 8, 22
  Bennettia 80
  Brevipinna 5
  Echinoptera 2, 80, 88, 231, 294, 359, 397
  Elegans 2, 4, 5
  Eschrichti 2, 4, 6
  Fimbriata 2, 81, 88, 207, 239, 397
  Granulifera 2, 5, 7, 8, 22
  Jukesi 80, 318
  Meridionalis 80, 397
  Milberti 2, 6, 7, 22
  Multicolor 4, 22, 110
  Multiradiata 80, 206
  Palmata 2, 4, 7, 22, 23
  Parvicirra .... 2, 36, 80, 81, 231, 408, 418, 428, 429, 481, 499, 502, 512, 548, 575, 628, 629, 677, 678, 681, 692.
  Paucicirra 2, 80, 88, 110, 294
  Pulchella 80
  Savignyi 2, 7, 8, 22
  Solaris 2, 80, 302, 359, 397
  Spinifera 2, 4, 5, 7, 8, 22, 23, 36, 110, 446, 451
  Stelligera 2, 80, 81, 88, 97, 110, 295, 397
  Tenella 2, 4, 292
  Typica 2, 80, 408, 418, 427, 428
  Valida 2, 81, 408, 601, 628, 629, 678, 681
Guettardicrinus 53
guttata, Actinometra 79, 604, 629, 679, 681
gyges, Dichrometra 33, 51
  Himerometra 6
Gymnocrinus 54
hagenii, Antedon 12, 13
  Coccometra 12, 292, 395
  Comatula 12
hamata, Comatula pectinata 352
    solaris var 339
  Comatula (?Actinometra) 337, 338, 341, 357
    (Comatula) solaris var 326
hana, Antedon 4, 57
  Stenometra 33
  Thalassometra 7, 21
hartlaubi, Antedon 3, 23
  Catoptometra 21
  Zygometra 5, 19, 20

Page
hartmeyeri, Comissia 52, 247 (in key), **267**, 681, 683; pl. 28, figs. 78, 79; pl. 29, figs. 80–82.
Hathrometra 12, 14, 15, 27, 39, 58
Hathrometra dentata 12
  norvegica 55
  prolixa 12
  sarsii 12, 396
  tenella 12
hawaiiensis, Antedon 4
  Naumachocrinus 49
  Thalassometra 7, 15, 33
helene, Cosmiometra 50
helgae, Atelecrinus 52
helianthoides, Petasometra 51
helianthus, Comatula 22, 41, 680, 681
  Himerometra 6, 9, 23
heliaster, Dichrometra 33
  Himerometra 10, 23
Heliometra 6, 9, 14, 15, 18, 27, 39, 57, 58
Heliometra antarctica 6
  asperrima 6
  brachymera 6, 27
  clio 6, 21
  eschrichtii 6, 17, 27
  glabra 6, 9
  glacialis 27, 28, 52, 95, 338, 423, 693
  glacialis biarticulata 29
    var. maxima 44
  hondoensis 6, 21
  inexpectata 6
  juvenalis 6, 9, 10
  laodice 6, 21
  magellanica 6
  mariae 6, 21
  maxima 6, 18, 27
  perplexa 6
  quadrata 6, 27
  rathbuni 6, 21
  rhomboidea 6, 9
  serratissima 6
  tanneri 6, 18
Heliometrinae 39, 58, 61, 63, 64, 65, 289
helius, Pachylometra 50
hepburniana, Antedon 4, 34
  Charitometra 8, 21, 27
  Strotometra 34
herdmani, Cenometra 38
?Heterias 409
Heterometra 32, 39
Heterometra affinis 32
  aspera 41
  bengalensis 32
  brockii 32

Page
Heterometra compta 38
  gravieri 46, 47
  joubini 46, 47
  pulchra 50, 52
  quinduplicava 32
  reynaudi 32
  reynaudii 627
  savignii 32, 45
  singularis 38
Heteroradiata, Echinodermata 40
hibernica, Trichometra 52, 58
Himerometra 6, 7, 14, 15, 32, 39, 53, 100, 549
Himerometra abbotti 6
  acuta 10
  affinis 6
  anceps 6, 31
  articulata 6
  bartschi 30, 32
  bella 6
  bengalensis 6, 31
  bidens 6
  bimaculata 6
  brevicuneata 6
  brockii 6
  clemens 6
  crassipinna 6, 21, 32
  delicatissima 6, 21
  discoidea 30
  döderleini 6, 21
  echinus 30
  elongata 6
  emendatrix 6
  ensifer 29
  erinacea 6
  finschii 6
  flagellata 6
  gracilipes 30
  grandis 29, 53
  gyges 6
  helianthus 6, 9, 23
  heliaster 10, 23
  imparipinna 6
  indica 6
  klunzingeri 6
  kraepelini 6, 32
  laevicirra 6
  ludovici 6
  magnipinna 30, 32
  marginata 6
  martensi 6, 32
  milberti 6, 31
  molleri 29
  monacantha 6, 31
  nematodon 6

Page
Himerometra occulta 6
  okelli 6
  oxyacantha 6
  paedophora 48, 49
  palmata 6
  persica 7, 9, 10, 31, 32
  philiberti 7, 32
  producta 29
  protectus 31
  pulcher 52
  quinduplicava 7, 31
  regalis 7
  reginae 7
  reynaudii 7
  robustipinna 30, 32, 46, 52
  savignii 7
  schlegelii 29
  sol 52
  spicata 7
  spinipinna 7
  stylifer 7, 17, 21
  subcarinata 15, 20, 38, 53
  subtilis 7
  tenera 7
  tenuipinna 7
  tessellata 7
  tuberculata 7
  unicornis 30
  variipinna 7, 31
Himerometridae 14, 15, 26, 31, 39, 50, 52, 61, 62, 65, 70 (in key), 72 (in key), 73 (in key), 75, 76, 157.
Himerometrinae 39, 52, 76
Hippasteria phrygiana 491
hirsuta, Antedon 9
  Thalassometra 44
  Thaumatometra 12
hispida, Comissia 44, 246 (in key), 257, **258**, 260, 261, 265; pl. 29, fig. 83
holmesi, Comatula 376, 394
Holocrinus 53
Holopidae 54
Holopodida 42
Holopus 42, 43, 54, 59
Holothuroidea 40
Homalometra denticulata 157
hondoensis, Antedon 3
  Heliometra 6, 21
horrida, Alecto 22
horridus, Comaster 44, 254
  Comissia 246 (in key), **254**; pl. 24 fig. 68
hupferi, Antedon 9, 45, 56
Hybometra 55, 58

Page
Hybometra senta 55
Hyocrinidae 43, 53
Hyocrinoida 43
Hyocrinus 43, 53, 57
Hypalocrinus 16, 25, 26, 53, 60
Hypalocrinus liliaceus 36
  naresianus 16, 28
  ornatus 38
  springeri 38, 52, 60
Hypalometra 14, 15, 39, 58, 284
Hypalometra defecta 292
Hyponome 5
Hyponome sarsii 51
iaponica, Actinometra 564
ignota, Comissia 46, 247 (in key), 269, 681
ignota minuta, Comissia 270
ignota var. minuta, Comissia 59, 270
Ilycrinus 57
Ilyocrinus recuperatus 38
imbricata, Charitometra 17
  Comantheria 484, 485 (in key), **515**, 519, 529, 681; pl. 29, fig. 87; pl. 62, fig. 173
  Comanthus 515
  Comaster 20, 515, 521
  Oligometra 29, 30, 32
  Pachylometra 34
imparipinna, Antedon 53
  Himerometra 6
imperialis, Actinometra 78, 79, 324, 328, 332, 333, 335, 336, 337, 338, 370
impinnata, Cyllometra 7, 31
Inadunata 54, 57
inaequalis, Charitometra 8, 14, 22
  Pachylometra 34
incerta, Aglaometra 55
  Antedon 34, 36
  Thalassometra 7
incisa, Antedon 8
  Charitometra 8, 34
incommoda, Compsometra 48, 59
indica, Antedon 430, 434
  Eumetra 35
  Himerometra 6
  Stephanometra 32, 45
  Tropiometra 52
indivisus, Eudiocrinus 13, 16, 19
inexpectata, Antedon 3
  Heliometra 6
infelix, Crotalometra 44
informis, Cyllometra 7, 31, 36
  Decametra 46
Innatantes 53
Innatantes, Comatulida 39

Page
insculpta, Crinometra 38
inserta, Comatula 691
insignis, Antedon 22, 23
insolitus, Nemaster 58, 226, 232, 240
insperatus, Pontiometra 36
insueta, Cenometra 38
intermedia, Actinometra 325, 337, 338
    Comantheria 58, 484 (in key), 506, 508, 529; pl. 60, fig. 169; pl. 61, figs. 171, 172; pl. 65, fig. 182
    Oligometra 50
interruptus, Metacrinus rotundus 25
interruptus f. ornatus, Metacrinus 59
intricata, Actinometra 30, 603, 604, 627, 628, 629, 632, 674, 679, 681
    Comanthus 29, 30, 37, 41, 604, 618, 629, 681
inusitata, Psathyrometra 50, 51
invenusta, Pachylometra 38
investigatoris, Pachylometra 35, 58
iowensis, Actinometra 219, 224
    Comaster 11, 24, 25, 219
    Nemaster 86, 215 (in key), 216, 218, 226, 235, 399, 400; pl. 18, figs. 40, 41.
Iridometra 12, 14, 26, 39, 58
Iridometra adrestine 12, 21
    aegyptica 46
    briseis 12, 21
    crispa 12, 13, 15, 58
    exquisita 36
    gracilis 51
    mauritiana 46
    melpomene 44
    minuta 12, 21
    nana 12, 36
    parvicirra 12
    psyche 12, 20
    scita 30
Iridometra (Eumetra) aphrodite 51
iridometriformis, Comatilia 36, 37, 64, 285; pl. 30, figs. 89–92
iris Compsometra 51
irregularis, Antedon 342, 358
Isis asteria 35, 60
isis, Antedon 3, 9
    Thaumatometra 12
Isocrinus 16, 23, 26, 27, 43, 53
Isocrinus blakei 25
    decorus 10, 23, 25, 26
    leuthardi 10
    naresianus 25
    pendulus 26

Page
Isocrinus (Cenocrinus) asteria 16, 26
    (Isocrinus) blakei 16, 26
        decorus 16, 26
Isometra 13, 14, 15, 27, 39, 58
Isometra angustipinna 13, 14
    vivipara 59
Isometrinae 58, 61, 63
japonica, Actinometra 564, 570, 575
    Alecto 80, 564, 574, 575
    Antedon 9
    Comanthus 87, 484, 529, 530 (in key), 539, 550, 554, 561, 564, 576, 577, 584, 585, 586; pl. 71, fig. 195; pl. 72, figs. 196–198; pl. 73, fig. 201; pl. 82, fig. 227.
    Comanthus (Bennettia) 565
    Comatula 79, 564, 574
    Oligometra 12, 20, 32
    Phanogenia 24, 564
japonica var. morsei, Actinometra 565, 570, 575
japonicus, Comanthus 565
    Democrinus braueri var 60
    Eudiocrinus 3, 16, 19, 20
    Pentametrocrinus 20, 21
joubini, Heterometra 46, 47
jukesi, Actinometra 310, 318
Jukesi group 80, 318
jukesii, Actinometra 47, 310, 318, 319, 681
    Actynometra 310
junceus, Eudiocrinus 49, 157
juvenalis, Heliometra 6, 9, 10
kerguelensis, Promachocrinus 50, 312
klunzingeri, Antedon 52
    Dichrometra 33, 45
    Himerometra 6
koehleri, Catoptometra 21
    Zygometra 5, 19
komachi, Cosmiometra 34
    Thalassometra 20, 34
kraepelini, Himerometra 6, 32
lacertosa, Compsometra 43
laevicirra, Himerometra 6
laevipinna, Prometra 50
laevis, Antedon 9, 58
    Thaumatometra 12
laevissima, Amphimetra 32
Lamprometra 53
laodice, Antedon 3
    Heliometra 6, 21
lata, Antedon 4
    Charitometra 8, 20
    Glyptometra 34

Page
lateralis, Charitometra........ 15, 58
  Glyptometra........ 34
latipinna, Antedon........ 34
  Thalassometra........ 7, 21
lepida, Asterometra........ 29
Leptometra........ 12, 14, 15, 27, 39, 58, 65
Leptometra celtica........ 12, 45
  phalangium........ 12, 45
Leptonemaster........ 37, 39, 81 (in key), 87, 88, 89 (in key), 228, **275**, 295
Leptonemaster venustus........ 37, 64, 130, 135, 231, 235, 269, **276**, 295, 388, 396, 398, 399; pl. 22, figs. 59–61.
leuthardi, Isocrinus........ 10
levigata, Pachylometra........ 36
liliaceus, Hypalocrinus........ 38
linearis, Actinometra........ 226
lineata, Actinometra........ 206, 207, 225, 230, 231, 239
  Actinometra echinoptera var........ 280
  Actinometra echinoptera var (?)........ 219, 226, 232, 399
  Antedon........ 9, 13, 14
  Comaster........ 11, 24, 25, 226
  Nemaster........ 221, 224, 226, 232, 235, 280
lineatus, Antedon........ 9, 14
Liparometra........ 53
Lithothamnion fruticulosum........ 622, 666
litoralis, Actinometra........ 604, 629
littoralis, Actinometra........ 408, 604, 610, 628, 629, 664, 681
  Comaster........ 11, 604
  Comissia........ 49, 246 (in key), 256; pl. 26, figs. 71, 72
  Phanogenia........ 24, 604
lofotensis, Rhizocrinus........ 17, 38
longicirra, Antedon........ 7
  Compsometra........ 51
  Ptilometra........ 7
longipinna, Antedon........ 9, 58
  Prometra........ 59
  Thaumatometra........ 12
Lophohelia........ 152
lovéni, Antedon........ 9, 12, 22, 23
  Compsometra........ 12, 108
  Eudiocrinus........ 59
ludovici, Antedon........ 52
  Craspedometra........ 32
  Himerometra........ 6
luna, Pachylometra........ 44
Luna marina........ 216, 218
Luna marina altera........ 357, 694
lusitanica, Antedon........ 34
  Thalassometra........ 7, 45

Page
luteofusca, Comanthus........ 594, 603
luteofuscum, Comanthus........ 594, 597, 602
lütkeni, Comissia........ 37, 208, 246 (in key), **249**, 255; pl. 24, figs. 66, 67
macilenta, Pachylometra........ 35
maclearanus, Pentacrinus........ 26, 60
macrobrachius, Actinometra........ 79, 158
  Capillaster........ 86, 157, **158**, 160, 294; pl. 8, figs. 25, 26
  Comaster........ 11, 158
  Phanogenia........ 24, 158
macrodiscus, Antedon........ 22
  Tropiometra........ 5, 51
macronema, Alecto........ 7, 10
  Comatula........ 7, 10, 47
  Pitlometra........ 7, 35, 48, 49, 55, 59
Macrophreata........ 53, 60, 61, 63, 64, 65, 71 (in key), 157, 215, 284
Macrophreata, Comatulida........ 39, 75
macropoda, Antedon........ 4, 7
  Asterometra........ 21, 64
  Ptilometra........ 7
maculata, Actinometra........ 99, 110, 111, 112, 156
  Comaster........ 11, 112
  Comatella........ 45, 46, 92 (in key), 105, **112**, 194, 685; pl. 20, fig. 50.
  Phanogenia........ 24, 112
madagascarensis, Craspedometra........ 46
magellanica, Antedon eschrichti var........ 22
  Florometra........ 55
  Heliometra........ 6
  Solanometra........ 51, 57
magna, Thalassometra........ 50
magnicirra, Antedon........ 14, 22, 34, 36
  Thalassometra........ 14, 27
magnifica, Actinometra........ 109, 492, 499, 502
  Calometra........ 35
  Catoptometra........ 30
  Comantheria........ 493
  Comanthus........ 492
  Comaster........ 11, 492
  Comissia........ 246 (in key), **247**, 249, 685
  Comissia peregrina........ 247
  Comissia peregrina var........ 59, 247
magnifica var. minor, Catoptometra........ 59
magnipeda, Asterometra........ 44
magnipinna, Himerometra........ 30, 32
major, Psathyrometra........ 50, 51
manca, Antedon........ 7
  Cyllometra........ 7, 9, 31, 36
margaritacea, Crinometra........ 38
margaritifera, Mariametra........ 38
  Thalassometra........ 50
marginalis, Thalassometra........ 50

Page
- marginata, Dichrometra 33
  - Himerometra 6
  - Oligometra 50
  - Stephanometra 45
  - Thalassometra 52
- mariae, Antedon 3
  - Capillaster 86, 158 (in key), **170**, 177, 207; pl. 12, fig. 32
  - Comaster 11, 21, 24, 25, 170
  - Comatula 4, 170
  - Heliometra 6, 21
  - Oreometra 52
- Mariametra 38, 39, 53, 62, 215
- Mariametra margaritifera 38
  - tenuipes 50
  - tuberculata 50
- Mariametrida 61, 62, 64, 65, 70 (in key), 76
- Mariametridae 50, 53, 61, 62, 65, 70 (in key), 73 (in key), 75, 76, 215
- Mariametrinae 39, 52, 76
- marina, Luna 216, 218, 357
- marina altera, Luna 357, 694
  - polyactis, Stella 216, 218, 357
- Marsupites 53
- Marsupitidae 39, 47
- Marsupitids 53
- martensi, Himerometra 6, 32
- Mastigometra 30, 39, 58
- Mastigometra flagellifera 29
  - micropoda 38
- mauritiana, Iridometra 46
- maxima, Antedon eschrichtii 3, 4
  - Heliometra 6, 18, 27
  - Heliometra glacialis var 44
- mediterranea, Antedon 27, 45, 56, 203, 356, 357
- melpomene, Iridometra 44
- Meridionalis group 80, 397
- meridionalis, Actinomedra 377
  - Actinometra 229, 231, 294, 295, 376, 395, 396, 397
  - Actinometra echinoptera f 384, 388
  - Actinometra echinoptera var 128, 231, 277, 280, 283, 326, 339, 378, 381, 382, 383, 385, 398
  - Alecto 376, 394, 395
  - Antedon 124, 376
  - Comactinia 50, 136, 277, 283, 378
  - Comactinia (Actinometra) 379
  - Comaster 11, 377
  - Comatula 80, 376
  - Phanogenia 24, 377

Page
- meridionalis var. carinata, Actinometra 276, 283, 377, 396
  - quadrata, Actinometra 377, 396
- meridionalis-carinata, Actinometra echinoptera var 129, 277, 280, 283, 378, 398
- meridionalis-pulchella, Actinometra echinoptera var 125, 130, 399
- meridionalis-rubiginosa, Actinometra echinoptera var 226, 229, 232, 378, 398
- meridionalis-valida, Actinometra echinoptera var 378, 382, 383, 398
- mertensi, Antedon 41, 634
  - Comatula 41, 632, 659, 675, 677, 678, 681
- Mesocrinus 53
- Metacrinus 16, 17, 23, 25, 26, 27, 53, 60, 265
- Metacrinus acutus 25
  - angulatus 10, 21, 25
  - batheri 35
  - batheri var. gracilis 52
  - cingulatus 25
  - costatus 25
  - cyaneus 59
  - interruptus f. ornatus 59
  - moseleyi 25
  - murrayi 25
  - murrayi nobilis 25
    - timorensis 25
  - nobilis 60
  - nobilis var. tenuis 59
  - nodosus 25
  - rotundus 10, 17, 19, 21, 23, 25, 44
  - rotundus interruptus 25
  - serratus 25
  - stewarti 25
  - suluensis 25
  - superbus 10, 21, 23, 25
  - superbus borealis 25, 26
    - tuberculatus 25, 26
  - tnberosus 25
  - varians 25
  - wyvillii 23, 25, 36, 60
  - zonatus 30
- meyeri, Actinometra 41, 604, 618, 627, 628, 629, 677, 678, 681, 682
- micraster, Comatula 38, 294, 320 (in key), 350, **373**; pl. 41, figs. 112, 113, 115–124
  - Comatula (Comatula) 373
- Microcomatula 82 (in key), 86, 87, 88, 89 (in key), **287**, 289, 400
- Microcomatula mortenseni 287
- microdiscus, Antedon 5
  - Zygometra 5, 37, 48
- micropoda, Mastigometra 38

Page
milberti, Amphimetra 32
Antedon 325, 337
Himerometra 6, 31
Milberti group 2, 6, 7, 22
milleri, Encrinites 60
Encrinus 11, 60
Millericrinus 53
minckerti, Nanometra 5, 9, 21
minima, Comaster 405, 412 (in key), **435**; pl. 52, fig. 156
Phanogenia 36, 435
Prometra 50
Psathyrometra 51
minimus, Comaster 435
minor, Antedon 4, 5, 9, 21
Catoptometra magnifica var 59
Comaster typica f 503
Eudiocrinus 35
minuta, Antedon 5, 9
Comissia 247 (in key), **270**, 690
Comissa ignota 270
Comissia ignota var 59, 270
Iridometra 12, 21
minutissima, Bathymetra 13, 15
mira, Psathyrometra 38
mirifica, Asterometra 38
möbiusi, Decametra 46
modica, Decametra 46
molleri, Amphimetra 32
Himerometra 29
mollis, Carpenterocrinus 21
Cyllometra 35
Decametra 50
Pentacrinus 21, 23
moluccana, Antedon 51
monacantha, Himerometra 6, 31
Stephanometra 32
Monachocrinus 53, 54, 57, 59
Monachocrinus sexradiatus 59
Monachometra 58
Monachometra mortenseni 60
moniliformis, Comatula 691
monilis, Comatula 691
monobrachius, Actinometra 158
moorei, Antedon 22
moroccana, Antedon 56
morsei, Actinometra 564, 570, 575
mortenseni, Amphimetra 38, 47
Argyrometra 58, 59
Microcomatula **287**
Monachometra 60
moseleyi, Metacrinus 25

Page
mülleri, Pentacrinus 16, 26, 60
Ptilomètra 35, 48, 49
multibrachiata, Actinometra 428, 437
Comaster 412 (in key), **437**, 440, 693; pl. 46, fig. 142
Comatula 10, 24, 437
Phanogenia 30, 36, 437
multicirra, Actinometra echinoptera 219, 224, 400
Comanthus solaster f 565
multicolor, Antedon 4, 52
Calometra 8, 20
Neometra 50, 110
Multicolor group 4, 22, 110
multifida, Actinometra 11, 414, 415, 421, 427, 428, 429, 458, 464, 466, 481, 482, 512, 513.
Alecto 35, 37, 47, 80, 168, 169, 204, 414, 425, 428, 429, 510, 512, 513, 544, 545
Comaster 168, 177, 192, 209, 406, 411, 412 (in key), **413**, 431, 433, 434, 435, 451, 510, 636, 642, 665, 666, 683; pl. 46, figs. 140, 141.
Comatula 79, 161, 168, 414, 426, 532
multiradiata, Actinometra 46, 113, 117, 118, 161, 168, 169, 170, 174, 205, 206, 207, 532
Alecto 161, 174, 414
Asterias 10, 35, 78, 79, 80, 168, 173, 203, 204, 208, 428, 429, 512, 513, 531, 545
Asterias (Comatula) 36
Asterias (Ophiura) 174
Capillaster 37, 45, 46, 86, 117, 157, 158 (in key). 164, 170, **173**, 209, 210, 212, 213, 214, 215, 229, 356, 397, 545, 627, 677, 683, 693; pl. 3, fig. 5; pl. 11, fig. 30; pl. 13, fig. 34; pl. 14, figs. 35, 36; pl. 81, figs. 222, 223.
Comaster 11, 21, 24, 25, 36, 170, 176, 207
Comatula 1, 10, 11, 23, 25, 35, 37, 78, 160, 168, 175, 204, 205, 413, 425, 428, 429, 512, 513, 539, 544, 545, 546, 549.
Comatula (Alecto) 161, 174, 175, 205, 532
Zygometra 5
multiradiata coccodistoma, Capillaster 46, 55, 212
multiradiata var. coccodistoma, Capillaster 212, 213, 214
Multiradiata group 80, 206
multiradiatus, Comaster 79, 413, 532, 545, 546, 548
multispina, Thalassometra 7, 27, 33, 45

Page
multistriata, Comatula 176
murrayi, Metacrinus 25
murrayi nobilis, Metacrinus 25
  timorensis, Metacrinus 25
mutabilis, Actinometra 41, 634, 648, 644, 647, 677, 678, 679, 681
  Antedon 652, 677
mylii, Encrinus 35
mylitta, Decametra 50
Myzostoma nigrescens 575
Myzostomum 693
Myzostomum cysticolum 276
nana, Antedon 9, 58
  Iridometra 12, 36
Nanometra 5, 14, 15, 26, 58
Nanometra bowersi 21
  clymene 51
  denticulata 5
  minckerti 5, 9, 21
  pusilla 5
  wilsoni 5
naresianus, Hypalocrinus 16, 26, 36
  Isocrinus 25
  Pentacrinus 16, 23, 25, 60
Naumachocrinus 49, 53
Naumachocrinus hawaiiensis 49
Nemaster 37, 39, 61, 82 (in key), 86, 88, 89 (in key), 123, **214**, 225, 228, 283
Nemaster discoidea 172, 215 (in key), 216, 223, 226, **232**, 280, 399, 400; pl. 19, figs. 46, 47; pl. 20, fig. 48.
  grandis 37, 215 (in key), **216**, 219, 226, 357; pl. 16, fig. 38; pl. 17, fig. 39
  insolitus 58, 226, 232, 240
  iowensis 86, 215 (in key), 216, **218**, 226, 235, 399, 400; pl. 18, figs. 40, 41
  lineata 221, 224, 226, 232, 235, 280
  rubiginosa 215 (in key), 216, 224, **225**, 226, 235, 240, 280, 294, 398, 399; pl. 19. figs. 42–45.
  sp 226
nematodon, Himerometra 6
Neocomatella 39, 46, 83 (in key), 86, 88 (in key), **122**, 145, 153, 215, 283, 294
Neocomatella alata 124 (in key), 125, **142**, 280; pl. 7, fig. 22
  atlantica 55, 125
  europaea 55, 124 (in key), 125, 150
  ornata 58, 143, 144, 150
  pulchella 88, 118, 123, **124**, 150, 280, 294, 395, 396, 399, 400; pl. 5, figs. 10–12; pl. 6, figs. 13, 14; pl. 7, fig. 21.

Page
Neocomatella pulchella var. alata 399
  sp. nov 150, 153
Neocrinus 60
Neocrinus decorus 80
Neometra 50, 52, 55
Neometra conaminis 55
  gorgonia 55
  multicolor 50, 110
  sibogae 50
Nepiometra 58
nigra, Actinometra 37, 92, 110
  Comatella 31, 36, 64, 90, 91 (in key), 92, 162; pl. 1, fig. 1; pl. 2. fig. 2; pl. 3. fig. 3
  Comatula 92
nigrescens, Myzostoma 575
nigrolineata, Coccometra 13
nobilis, Actinometra 41, 458, 464, 466, 472, 477, 482
  Comanthus 30, 36, 467, 482
  Comanthus (Comanthina) 467
  Comaster 11, 467
  Metacrinus 60
  Metacrinus murrayi 25
  Phanogenia 24, 467
nobilis var. tenuis, Metacrinus 59
nodosus, Metacrinus 25
norvegica, Hathrometra 55
notata, Actinometra 88, 98, 101, 109, 110, 111, 121, 294
  Comatula 10, 24, 99
Notocrinida 61, 63
Notocrinidae 59, 61, 63, 64, 65, 71 (in key), 73 (in key)
Notocrinus virilis 59
novae-guineae, Actinometra 415, 428, 437, 466, 481
  Alecto 10, 80, 413, 425, 426, 427, 429, 442, 481
  Comaster 39, 440, 442, 443
novae-Guineae, Comatula 79, 414, 426, 466
novae-guineae, Phanogenia 24, 30, 416, 429, 440, 441
novaeguinea, Comaster 417
novaeguineae, Comaster 11, 416, 417, 427, 430, 441
novaezealandiae, Comanthus 59, 529, 531 (in key), 584, 586, 588, 596
nudus, Phrynocrinus 2, 21
nutrix, Thaumatometra 59
nympha, Epimetra 44
obscura, Trichometra 38
occidentalis, Oligometra serripinna 46
occulta, Dichrometra 33

Page
occulta, Himerometra 6
Oceanometra 58
okelli, Dichrometra 33
  Himerometra 6
Oligometra 12, 14, 15, 32, 41, 284
Oligometra adeonae 12, 32
  bidens 12, 32, 37
  caledoniae 47
  caribbea 12, 13, 15, 32
  carpenteri 12, 32
  concinna 52
  gracilicirra 30, 32, 57
  gracilicirra ornata 44
  imbricata 29, 30, 32
  intermedia 50
  japonica 12, 20, 32
  marginata 50
  pinniformis 12, 32
  pulchella 29, 31, 32, 36
  serripinna 12, 32
  serripinna var. electrae 46
  serripinna occidentalis 46
  studeri 35, 36
  thetidis 57
Oligometrides 55
Oligometrides adeonae 55, 506, 511
Oligophreata 53, 60, 64, 65, 69 (in key), **74**, 76, 157, 215, 284
Oligophreaten 75
Oligophreata, Comatulida 39, 74, 75
omissa, Thalassometra 45
Onychophora 56
Ophiobrachiata 40
Ophiocrinus 1
Ophiomaza 164, 351
ophiura, Catoptometra 44
Ophiuroidea 40
Orbitolites 622, 666, 667
Oreometra 52
Oreometra mariae 52
orientalis, Antedon 5, 9, 21
  Comaster 11, 635
  Comatula 4, 41, 635, 680, 681
  Phanogenia 24, 635
orion, Antedon 4, 14, 33
  Charitometra 8
  Parametra 33
  Thalassometra 20
ornata, Neocomatella 58, 143, 144, 150
  Oligometra gracilicirra 44
ornatissima, Strotometra 50
ornatus, Eudiocrinus 35, 38
  Hypalocrinus 38
Orthometra 58

Page
ouifer, Encrinus 35
Ovozoa 40
oxyacantha, Himerometra 6
  Stephanometra 32
owstoni, Prometra 58
Oxymetra 33, 39, 53
Pachylometra 34
Pachylometra angusticalyx 34
  brevipinna 34
  crassa 50
  distincta 18, 34
  flexilis 34
  fragilis 50, 58
  helius 50
  imbricata 34
  inaequalis 34
  invenusta 38
  investigatoris 35, 58
  levigata 36
  luna 44
  macilenta 35
  patula 34
  robusta 34
  sclateri 34, 45
  selene 44
  septentrionalis 44
  smithi 34
pacificus, Bathycrinus 2, 21
paedophora, Himerometra 48, 49
Palaeocomatella 49, 61, 83 (in key), 86, 88 (in key), **153**
Palaeocomatella difficilis 118, **154**; pl. 7, figs. 23, 24
palmata, Dichrometra 33, 37, 45, 52
  Himerometra 6
Palmata group 2, 4, 7, 22, 23
papuensis, Amphimetra 55
paradoxus, Bathycrinus 38
Parametra 33
Parametra compressa 33, 36
  fisheri 33
  orion 33
parfaiti, Rhizocrinus 38, 45
parilis, Amphimetra 38
parrae, Encrinus 11, 16, 26
  Endoxocrinus 16, 23, 26
parva, Prometra 50
  Psathyrometra 44
  Thaumatometra 12, 13, 15, 21
parvicirra, Actinometra 37, 176, 207, 257, 408, 444, 446, 447, 448, 451, 467, 482, 492, 502, 548, 589, 592, 593, 596, 598, 604, 610, 628, 629, 632, 638, 676, 678, 679, 680.

Page
parvicirra, Aetinometra 633
Alecto 30, 41, 49, 79, 80, 628, 629, 631, 644, 661, 674, 675, 676, 681
Antedon 9
Comanthus 47, 192, 205, 207, 209, 269, 270, 318, 405, 406, 408, 411, 450, 451, 455, 456, 520, 528, 570, 594, 599, 601, 602, 603 (in key), 605, 606, 607, 610, 611, 620, 627, 628, 629, 630, **631**, 679, 693; pl. 29, fig. 88; pl. 65, fig. 184; pl. 73, fig. 200; pl. 78, figs. 209, 210; pl. 79, figs. 211–214; pl. 80, figs. 215–218; pl. 81, fig. 221.
Comanthus (Comanthus) 406, 529, 635
(Validia) 45, 269, 636
?Comanthus (Validia) 267, 681
Comanthus (Vania) 55, 177, 636
Comaster 11, 20, 451, 455, 635, 680
Comatula 592, 631, 674
Comatula (Alecto) 631, 674
Iridometra 12
Phanogenia 24, 635
Vania 637
parvicirra typus A, Actinometra 593, 596, 598, 601, 602, 628, 647, 649, 679
typus B, Actinometra 596, 598, 601, 602, 629, 647, 679
parvicirra f. comanthipinna, Comanthus 59, 406, 407, 636, 649, 664, 665
Comanthus (Vania) 636, 683
comasteripinna, Comanthus 59, 406, 503, 636, 648, 650, 651, 664, 665, 684
Comanthus (Vania) 636, 683
vaniipinna, Comanthus 60, 650, 651, 684
Comanthus (Vania) 684
vanipinna, Comanthus 636, 664, 665
(?parvicirra), Comanthus 267
Parvicirra group 2, 36, 80, 81, 231, 408, 418, 428, 429, 481, 499, 502, 512, 548, 575, 628, 629, 677, 678, 681, 692
parvicirrum, Comanthus 602, 636
parvicurva, Actinometra 634
parviflora, Compsometra 51, 87
parvipinna, Charitometra 8
Strotometra 34
parvula, Antedon 9
Comissia 49, 246 (in key), 259, 261, **262**, 266, 267, pl. 28, fig. 77
Thaumatometra 12
parvus, Comaster 38, 411, 444, 447, 451
patula, Charitometra 8
Pachylometra 34

Page
pauciciria, Actinometra 310
paucicirra, Actinometra 47, 109, 155, 310, 315, 318, 319, 342, 589, 681
Comatula 10, 21, 24, 119, 121, 294, 310
Paucicirra group 2, 80, 88, 110, 294
paupera, Toxometra 44
pectinata, Actinometra 46, 269, 270, 302, 336, 341, 342, 357, 358, 359, 361, 370
Asterias 78, 79, 80, 173, 203, 204, 336, 337, 339, 356, 357, 694
Asterias (Euryale) 340
Comatula 10, 24, 30, 36, 39, 41, 203, 250, 274, 294, 295, 308, 320 (in key), 323, 330, 331, 335, 337, 338, 339, 359, 360, 361, 362, 363, 365, 366, 371, 372, 375, 396, 397, 398, 661, 675, 679, 692; pl. 20, fig. 49; pl. 33, fig. 100; pl. 34, fig. 101; pl. 35, fig. 102; pl. 36, fig. 103; pl. 37, fig. 104; pl. 38, figs. 105–107.
Comatula (Comatula) 342
Comatula pectinata 352
pectinata affinis, Comatula 352
hamata, Comatula 352
pectinata, Comatula 352
var. purpurea, Comatula 361
pectinifer, Comissia 46, 246 (in key), **255**; pl. 25, figs. 69, 70
Pectinometra 52
Pelmatozoa 40
pendulus, Isocrinus 26
Pentacrinidae 43, 53, 60
Pentacrinids 53
Pentacrinites caput-medusae 60
fossilis 23
Pentacrinitidae 56
Pentacrinus 16, 53
Pentacrinus balfouri 23
decorus 16, 60
maclearanus 26, 60
mollis 21, 23
mülleri 16, 26, 60
naresianus 16, 23, 25, 60
wyville-thomsoni 60
wyvillethomsoni 10
Pentametrocrinidae 13, 14, 19, 28, 39, 61, 64, 65, 71 (in key), 72 (in key), 157, 284
Pentametrocrinus 3, 13, 14, 19, 25, 63, 64, 284
Pentametrocrinus atlanticus 13, 45
diomcdeae 21, 30
japonicus 13, 20, 21
semperi 13
tuberculatus 13, 20, 21

Page
Pentametrocrinus varians ... 13, 21
peregrina, Actinometra ... 248, 249
    Comissia ... 246 (in key), 248; pl. 24, fig. 65
peregrina magnifica, Comissia ... 247
    var. magnifica, Comissia ... 59, 247
perelegans, Stella chinensis ... 173, 203, 356
pergracilis, Thalassometra ... 7, 9, 33
Perissometra ... 58
Perissometra aranea ... 59
    carinata ... 60
Perometra ... 7, 14, 15, 26, 39, 58, 284
Perometra afra ... 46
    balanoides ... 7
    diomedeae ... 7, 20
    elongata ... 30
Perometrinae ... 39, 58, 61, 63, 64, 65, 284
peroni, Actinometra ... 533, 537, 548
peronii, Actinometra ... 538, 547, 549
    Comaster ... 11, 533
    Phanogenia ... 24, 533
perplexa, Antedon ... 3
    Heliometra ... 6
    Prometra ... 60
    Thalassometra ... 50
perplexum, Comantheria ... 484 (in key), **506**
perrieri, Bathycrinus ... 45
persica, Himerometra ... 7, 9, 10, 31, 32
perspinosa, Antedon ... 31
    Colobometra ... 31
    Cyllometra ... 7
Petasometra ... 51, 284
Petasometra helianthoides ... 51
petasus, Antedon ... 27, 56, 384, 661
phalangium, Alecto ... 12
    Antedon ... 9
    Leptometra ... 12, 45
Phanogenia ... 1, 2, 24, 25, 26, 30, 36, 89, 123, 156, 214, 374, 410, 457, 465, 483, 527, 680
Phanogenia alata ... 24, 125
    alternans ... 24, 489
    belli ... 24, 458
    bennetti ... 24, 533
    briareus ... 24, 492
    carpenteri ... 24, 36, 47, 416, 510
    delicata ... 36, 521
    distincta ... 448
    divaricata ... 24, 492
    duplex ... 24, 467
    echinoptera ... 24, 377
    elongata ... 24
    gracilis ... 24, 431
    grandicalyx ... 24, 513
    japonica ... 24, 564
    meridionalis ... 24, 377

Page
Phanogenia littoralis ... 24, 604
    macrobrachius ... 24, 158
    maculata ... 24, 112
    magnifica ... 24, 492
    meridionalis ... 24, 377
    minima ... 36, 435
    multibrachiata ... 30, 36, 437
    nobilis ... 24, 467
    novae-guineae ... 24, 30, 416, 429, 440, 441
    orientalis ... 24, 635
    parvicirra ... 24, 635
    peronii ... 24, 533
    quadrata ... 24
    regalis ... 24, 467
    robustipinna ... 24, 553
    rotalaria ... 24, 635
    rubiginosa ... 24, 226
    schlegelii ... 24, 467
    serrata ... 24, 452
    solaster ... 24, 576
    stelligera ... 24, 99
    trichoptera ... 24, 580
    typica ... 24, 30, 36, 414, 426, 428, 429, 485
    valida ... 24, 604
    variabilis ... 24, 416
philiberti, Alecto ... 47
    Himerometra ... 7, 32
philippinensis, Comaster ... 440, 442
    Cosmiometra ... 44
Philippinische Comatula-Art ... 632
Phrixometra ... 58
phrygiana, Hippasteria ... 491
Phrynocrinidae ... 42, 53
Phrynocrinus ... 26, 42, 43, 49, 53
Phrynocrinus nudus ... 2, 21
Phyllocrinus ... 54
picta, Comatula ... 46
    Tropiometra ... 45, 46, 144
pinguis, Bennettia ... 39
    Comanthus ... 87, 405, 468, 484, 529, 530 (in key), **553**, 565, 566, 570, 572, 574, 577, 584; pl. 70, figs. 192, 193; pl. 71, fig. 194.
    Comanthus (Bennettia) ... 554
    Comanthus (Comanthus) ... 38, 554, 563
pinnatus, Eudiocrinus ... 49
    Ptilocrinus ... 3, 26
pinniformis, Oligometra ... 12, 32
plana, Trichometra ... 52
planata, Actinometra echinoptera var. pulchella subvar ... 125, 127, 128, 131, 133, 134, 135, 136, 137, 145, 399

Page
Platycrinus 43
Platysamia cecropia 42
plectrophorum, Comanthus 59, 459, 529, 530 (in key), **550**; pl. 23, fig. 62; pl. 69, figs. 190, 191.
Plicatocrinidae 53, 54, 57
Plicatocrinus 53
Poecilometra 8, 14, 15, 34
Poecilometra acoela 8, 17, 21, 34
  scalaris 8, 34
polyactinia, Comatula 691
polyactinis, Comatula 691
?Polyactis 302, 409
polyactis, Stella marina 216, 218, 357
polycnemis, Comantheria 429, 483, 484 (in key), **485**, 489, 490; pl. 56, fig. 162
  Comanthus 36, 429, 485, 489
polymorpha, Actinometra 41, 80, 598, 604, 619, 621, 627, 628, 632, 646, 652, 653, 654, 655, 658, 661, 663, 675, 676, 677, 678, 681.
  Comatula 632
pontifer, Thalassocrinus 44
Pontiometra 6, 14, 15, 31, 39
Pontiometra andersoni 6, 31, 33
  insperatus 36
Pontiometridae 39, 53, 76
porrecta, Antedon 14, 34
  Crotalometra 153
  Thalassometra 14, 27
Poteriocrinidae 54
pourtalèsi, Antedon 17, 18
  Atelecrinus 4
  Charitometra 8
priamus, Strotometra 50
pristina, Zygometra 44
producta, Amphimetra 32
  Himerometra 29
profundorum, Psathyrometra 15
Proisocrinus 43, 53
Proisocrinus ruberrimus 44
prolixa, Antedon 9
  Hathrometra 12
Promachocrinus 1, 2, 5, 14, 15, 18, 39, 57, 58, 294
Promachocrinus kerguelensis 50, 312
Prometra 50, 52, 284
Prometra brevicirra 50
  laevipinna 50
  longipinna 59
  minima 50
  owstoni 58
  parva 50

Page
Prometra perplexa 60
propinqua, Amphimetra 50
  Antedon 4
  Calometra 8, 21
  Crotalometra 44
protectus, Dichrometra 33, 37, 45, 52
  Himerometra 31
Protomyzostomum 527
Psathyrometra 6, 14, 15, 20, 39, 58
Psathyrometra anomala 51
  bigradata 6
  borealis 15
  congesta 15
  erythrizon 6
  fragilis 6, 20
  gracillima 38
  inusitata 50, 51
  major 50, 51
  minima 51
  mira 38
  parva 44
  profundorum 15
  wireni 59
  sp 9
psyche, Antedon 9, 10, 58
  Iridometra 12, 20
Pterocrinus 23
Pterometra 39, 49, 61, 63
Pterometra venusta 50
Ptilocrinida 42, 43
Ptilocrinus 3, 26, 53, 57
Ptilocrinus antarcticus 26, 31
  pinnatus 3, 26
Ptilometra 7, 10, 14, 15, 26, 48, 49, 64
Ptilometra anthus 7
  australis 64
  dorcadis 35, 37, 47, 49
  longicirra 7
  macronema 7, 35, 48, 49, 55, 59
  macropoda 7
  mülleri 35, 48, 49
  pulcherrima 36
  splendida 38
  trichopoda 30, 39
Ptilometrinae 56, 64, 65, 71 (in key), 74 (in key)
pubescens, Antedon 4
  Thalassometra 7, 21, 27, 33
Pulchella group 80
pulchella, Actinometra 11, 18, 112, 115, 118, 124, 142, 143, 149, 150, 152, 154, 155, 156, 231, 294, 295, 396, 397.
  Actinometra (Neocomatella) 153

Page
pulchella Actinometra echinoptera var 125, 127, 128, 136, 137, 145, 146, 150, 280, 378, 379, 399.
Actinometra echinoptera var. pulchella subvar 399
Actynometra 150
Antedon 124, 131, 133, 135, 142, 149
Comatella 125
Cyllometra 59
Ganymeda 142
Neocomatella 88, 118, 123, **124**, 150, 280, 294, 395, 396, 399, 400; pl. 5, figs. 10–12; pl. 6, figs. 13, 14; pl. 7, fig. 21.
Oligometra 29, 31, 36
pulchella var. alata, Neocomatella 399
subvar. alata, Actinometra echinoptera var 127, 134, 136, 137, 143, 145, 146, 147, 399
planata, Actinometra echinoptera var 125, 127, 128, 131, 133, 134, 135, 136, 137, 145, 399
pulchella, Actinometra echinoptera var 399
pulchellus, Eudiocrinus gracilis var 59
pulcher, Comaster 49, 413 (in key), 443, 448; pl. 50, figs. 148, 149
Himerometra 52
pulcherrima, Ptilometra 36
pulchra, Crinometra 38
Heterometra 50, 52
pumila, Antedon 9, 12, 22
punctata, Zygometra 49
purpurea, Actinometra 342, 358, 361, 370
Alecto 43, 79, 80, 336, 359, 360, 370, 371
Comatula 48, 55, 294, 320 (in key), 323, 335, 337, 343, 348, 356, **360**, 372, 626, 658; pl. 39, figs. 108, 109; pl. 40, fig. 111; pl. 41, fig. 114
Comatula (Comatula) 361
Comatula pectinata var 361
Toxometra 51
pusilla, Nanometra 5
pyramidalis, Zenometra 15
quadrata, Actinometra 406, 408, 634, 638, 646, 658, 664, 665, 678, 681
Actinometra meridionalis var 377, 396
Antedon 52
Comaster 11
Heliometra 6, 27
Phanogenia 24
quinduplicava, Heterometra 32
Himerometra 7, 31

Page
quinquecostata, Antedon 4, 33
Stenometra 33, 41
Thalassometra 7, 20
radiata, Asterias 341
radiatus, Encrinus 35
rara, Antedon 3
rathbuni, Antedon 3
Heliometra 6, 21
rawsoni, Rhizocrinus 38
recubariensis, Apiocrinus 38
recuperatus, Bathycrinus 45
Ilyocrinus 38
regalis, Actinometra 467
Actinometra 437, 439, 467, 472, 473, 474, 475, 481, 482, 548
Comanthus 467
Comaster 11, 467
Dichrometra 33
Himerometra 7
Phanogenia 24, 467
reginae, Antedon 51
Dichrometra 33
Himerometra 7
remota, Antedon 9, 58
Thaumatometra 12
renovatus, Thaumatocrinus 50
reynaudi, Heterometra 32
reynaudii, Heterometra 627
Himerometra 7
Rhizocrinidae 42
Rhizocrinus 14, 27, 38, 42, 43, 53, 57, 422
Rhizocrinus brevis 38
chuni 38, 45
conifer 38
lofotensis 17, 38
parfaiti 38, 45
rawsonii 38
robustus 38
sabae 38
verrilli 14
weberi 38
rhomboidea, Antedon 22
Heliometra 6, 9
robusta, Actinometra 80, 325, 328, 329, 330, 331, 336, 337, 338, 339, 358
Charitometra 8
Chlorometra 44, 58
Pachylometra 34
robustipinna 24, 553
robustipinna, Actinometra 46, 52, 533, 549, 553, 563
Comanthus 549, 553
Comaster 11, 20, 553

Page

- robustipinna, Himerometra 30, 32, 46, 52
- robustum, Antedon (Actinometra) 326, 338
- robustus, Rhizocrinus 38
- rosacea, Comatula 694
- rosea, Actinometra 297, 302
  - Alecto 48, 79, 80, 296, 298, 301
  - Comatula 296, 301, 302
- rosularis, Comatula 342
- rotalaria, Actinometra 47, 49, 317, 628, 632, 658, 664, 679, 680, 681
  - Alecto 309, 317
  - Comanthus 30, 36, 37, 456, 520, 604, 635, 680
  - Comanthus (Comanthus) 41, 455, 515, 593, 602, 604, 629, 635, 681
  - Comaster 11, 635
  - Comatula 30, 41, 47, 49, 79, 80, 109, 205, 294, 307, **309**, 317, 318, 319, 322, 344, 439, 628, 629, 675, 676, 679, 681, 682, 693; pl. 32, fig. 98.
  - Comatula (Actinometra) 309
  - Phanogenia 24, 635
- rotula, Comantheria 49, 484 (in key), 486, **503**, 683; pl. 58, fig. 165
  - Comanthus 503
- rotularia, Comatula 309
- rotularis, Comatula 309
- rotundus, Metacrinus 10, 17, 19, 21, 23, 25, 44
- rotundus interruptus, Metacrinus 25
- ruber, Antedon 4, 12
  - Cyllometra 7
  - Erythrometra 12, 20
- ruberrimus, Proisocrinus 44
- rubiginosa, Actinometra 225, 229, 231, 239, 294, 295, 377, 397
  - Actinometra echinoptera var 226, 232, 280, 379, 398
  - Antedon 225, 230
  - Comaster 11, 226
  - Nemaster 215 (in key), 216, 224, **225**, 226, 235, 240, 280, 294, 398, 399; pl. 19, figs. 42–45.
  - Phanogenia 24, 226
- rubiginosa-discoidea, Actinometra echinoptera var 232, 238, 239, 400
- rubroflava, Antedon 4
  - Catoptometra 21
  - Zygometra 5, 19
- rugosus, Decametrocrinus 15
- rustica, Crotalometra 35
- sabae, Rhizocrinus 38
- Sabinella capillastericola 181

Page

- Saccocoma 54
- Saccocomidae 54
- samoana, Bennettia 39
  - Comanthus 411, 529, 531 (in key), **593**, 599, 601, 602, 628, 639, 640, 648, 649, 658, 662, 677, 679, 681, 682; pl. 78, fig. 208; pl. 81, figs. 219, 220.
  - Comanthus (Bennettia) 594
  - Comanthus (Cenolia) 594
  - Comanthus (Comanthus) 38, 593
- samoanum, Comanthus 594, 602
- Saracrinus 60
- Sarametra 58
- sarsii, Hathrometra 12, 396
  - Hyponome 51
- savignii, Alecto 23
  - Heterometra 32, 45
  - Himerometra 7
- Savignyi group 2, 7, 8, 22
- scalaris, Antedon 4
  - Antedon (Poecilometra) 17
  - Peocilometra 8, 34
- Scalpellum 141, 280
- schlegeli, Actinometra 466, 548
- schlegelii, Actinometra 466, 471, 481, 482
  - Amphimetra 32
  - Comanthina 87, 419, 424, 427, 457, 458 (in key), 464, **466**, 544, 577, 693; pl. 53, fig. 158; pl. 54, fig. 159; pl. 55, figs. 160, 161; pl. 64, fig. 180.
  - Comanthus 459, 465, 467
  - Comanthus (Comanthina) 467
  - Comaster 11, 467
  - Himerometra 29
  - Phanogenia 24, 467
- schönovi, Comaster 412, **443**; pl. 64, fig. 179
- scita, Iridometra 30
- scitulus, Comaster (?) 44, 274
  - Comissia 246 (in key), **274**
- sclateri, Antedon 14, 22
  - Charitometra 14
  - Pachylometra 34, 45
- selene, Pachylometra 44
- Selenemetra 44
- Selenemetra tenuicirra 50
  - viridis 44
- semperi, Eudiocrinus 19
  - Pentametrocrinus 13
- senta, Hybometra 55
- sentifera, Crotalometra 38

Page

sentosa, Actinometra 37, 161, 206

Capillaster 55, 64, 86, 87, 158 (in key), **160**, 169, 170, 180, 204, 205, 426, 544, 693; pl. 9, fig. 28; pl. 10, fig. 29; pl. 11, fig. 31.

Comaster 11, 24, 25, 30, 36, 161

separata, Antedon 4

Calometra 8, 20

septentrionalis, Pachylometra 44

serrata, Antedon 9, 10

Comanthus 452

Comaster 21, 413 (in key), 448, **451**, 680, 686, 690; pl. 52, fig. 154

Comatula 4, 451

Compsometra 12, 20, 574

Phanogenia 24, 452

serratissima, Antedon 3

Heliometra 6

serratus, Bathycrinus 14

Comaster 447

Metacrinus 25

serripinna, Antedon 9, 12, 46

Eudiocrinus 30

Oligometra 12, 32

serripinna var. electrae, Oligometra 46

serripinna occidentalis, Oligometra 46

sexradiatus, Monachocrinus 59

sibogae, Atopocrinus 51

Comaster 49, 413 (in key), **442**; pl. 51, fig. 152

Endoxocrinus 16, 26

Neometra 50

simplex, Actinometra 41, 99, 110, 111, 118, 406 634, 645, 664, 665, 678, 679, 680, 681

Comatula 41, 361, 370, 634, 644, 680, 681

sinensis, Euantedon 51

singularis, Heterometra 38

smithi, Charitometra 30

Pachylometra 34

socialis, Uintacrinus 19

sol, Himerometra 52

Solanocrinus 545, 546, 547

Solanocrinus costatus 546

Solanometra 49, 58

Solanometra magellanica 51, 57

solaris, Actinometra 302, 318, 320, 324, 337, 339, 341, 357, 361, 370

Alecto 324, 335

Antedon 324

Comatula 10, 23, 24, 37, 78, 80, 81, 192, 205, 294, 300, 314, 320 (in key), 321, 322, **323**, 339, 343, 349, 357, 370, 396, 398, 675, 691, 693; pl. 33, fig. 99.

Page

solaris, Comatula solaris var 320

Comatula (Actinometra) 324, 335, 357

(Comatula) 326

(Comatula) solaris var 326

solaris gracilior, Comatula 335

solaris solaris, Comatula 335, 339

var., Comatula (Actinometra) 340

var. albonotata, Actinometra 325, 337

hamata, Comatula 339

Comatula (Comatula) 326

solaris, Comatula 320

Comatula (Comatula) 326

Solaris group 2, 80, 302, 359, 397

solaster, Comanthus 508, 529, 530 (in key), 561, 565, 566, 572, **576**, 584; pl. 20, fig. 51.

Comanthus (Bennettia) 576

(Comanthus) 576

Comaster 11, 21, 576

Comatula 4, 576

Phanogenia 24, 576

solaster f. multicirra, Comanthus 565

soluta, Cyllometra 38

spanoschistum, Comanthoides **241**, 246 (in key), 251; pl. 21, figs. 52–57; pl. 22, fig. 58; pl. 23, fig. 63.

Comanthus 241, 250, 251, 253, 587

Comissia 59, 241

spicata, Antedon 46

Himerometra 7

Stephanometra 32

spinicirra, Stiremetra 33

Thalassometra 7

spinifera, Antedon 10

Stylometra 33

Thalassometra 7

Spinifera group 2, 4, 5, 7, 8, 22, 23, 36, 110, 446, 451

spinipinna, Actinometra 565, 571, 575, 586

Himerometra 7

Stephanometra 32

spinosissima, Calometra 35

Comissia 49, 246 (in key), **259**, 365; pl. 27, figs. 73, 74

splendida, Ptilometra 38

springeri, Hypalocrinus 38, 52, 60

Stella chinensis perelegans 173, 203, 356

Stella marina polyactis 216, 218, 357

Stella (Decameros) barbata 357

stella, Antedon 9, 22

Stellarides 40

stellata, Actinometra 79, 414, 426, 427, 428, 431

stellatus, Antedon 422

stelligera, Actinometra 92, 98, 118

Page
stelligera, Actinometra (Comatula) 36
    Comaster 11, 99
    Comatella 88,
        91, 92 (in key), 94, 95, 97, 98, 113, 117,
        294, 685; pl. 4, figs. 6–9.
    Pnanogenia 24, 99
Stelligera group 2, 80, 81, 88, 97, 110, 295, 397
Stenometra 33
Stenometra acuta 50
    arachnoides 36
    conifera 33
    cristata 44
    dentata 59
    diadema 33
    dorsata 41
    hana 33
    quinquecostata 41
Stephanometra 32, 39, 45
Stephanometra acuta 32
    coronata 38
    echinus 32
    indica 32, 45
    marginata 45
    monacantha 32
    oxyacantha 32
    spicata 32
    spinipinna 32
    tenuipinna 32, 36
    tuberculata 32
Stephanometridae 61, 62, 76
Stephanometrinae 39, 52, 76
stewarti, Actinometra 176, 206
    Metacrinus 25
stilligera, Actinometra 98
Stiremetra 33
Stiremetra acutiradia 33
    breviradia 33
    carinifera 52
    spinicirra 33
strata, Actinometra 326
striata, Actinometra 326
strota, Actinometra 325, 331, 333, 338
    Actynometra 326
Strotometra 34
Strotometra hepburniana 34
    ornatissima 50
    parvipinna 34
    priamus 50
studeri, Cyllometra 36, 37
    Oligometra 35, 36
stylifer, Antedon 4
    Himerometra 7, 17, 21
Stylometra 15, 27, 33

Page
Stylometra spinifera 33
    sp 33
suavis, Colobometra 31
    Cyllometra 30, 31
subcarinata, Dichrometra 33
    Himerometra 15, 20, 38, 53
subtilis, Dichrometra 33
    Himerometra 7
sulcata, Crotalometra 50
sulcatus, Atelecrinus 51
suluensis, Metacrinus 25
superbus, Metacrinus 10, 21, 23, 25
superbus borealis, Metacrinus 25, 26
    tuberculatus, Metacrinus 25, 26
tanneri, Heliometra 6, 18
taprobanes, Cyllometra 38
    Decametra 46
tasmaniae, Comanthus 59,
        241, 244, 529, 531 (in key), 584, **586**, 588
taviana, Comantheria 484 (in key),
        510; pl. 63, figs. 176, 177
    Comaster 47, 429, 430, 510, 513
Teliocrinus 60
Teliocrinus asper 60
tenax, Actinometra 79, 98, 110
    Antedon 98, 109
tenella, Antedon 9
    Comaster 412, 413 (in key), 448,
        455, 456, 663, 681; pl. 51, figs. 150, 151
    Hathrometra 12
Tenella group 2, 4, 292
tenelloides, Antedon 3, 6
    Thysanometra 6, 14, 21
tenera, Antedon 51
    Dichrometra 33, 48
    Himerometra 7
tenuicirra, Antedon 9, 14
    Capillaster 49, 157,
        158 (in key), 170, **209**; pl. 15, fig. 37
    Comatula 49, 294,
        320 (in key), 361, **372**; pl. 39, fig. 110
    Selenemetra 50
tenuipes, Adelometra 15
    Mariametra 50
tenuipinna, Himerometra 7
    Stephanometra 32, 36
tenuis, Antedon 3, 9, 22
    Metacrinus nobilis var 59
    Thaumatometra 20
tessellata, ?Amphimetra 32
    Himerometra 7
Tetracrinus 53, 54
Thalassocrinus 44, 53, 57

Page
Thalassocrinus pontifer 44
Thalassometra 7, 8, 14, 15, 20, 22, 27, 28, 33
Thalassometra acutiradia 7
  agassizii 7, 33
  alboflava 7, 21
  aster 7, 20
  attenuata 38
  bispinosa 7, 27, 33
  breviradia 7
  compressa 31
  crassicirra 15
  delicata 15
  diadema 7, 21
  duplex 7
  echinata 7, 33
  fisheri 15
  flava 14, 27
  gigantea 15, 27, 33, 58
  hana 7, 21
  hawaiiensis 7, 15, 33
  hirsuta 44
  incerta 7
  komachi 20, 34
  latipinna 7, 21
  lusitanica 7, 45
  magna 50
  magnicirra 14, 27
  margaritifera 50
  marginalis 50
  marginata 52
  multispina 7, 27, 33, 45
  omissa 45
  orion 20
  pergracilis 7, 9, 33
  perplexa 50
  porrecta 14, 27
  pubescens 7, 21, 27, 33
  quinquecostata 7, 20
  spinicirra 7
  spinifera 7
  valida 7
  villosa 27, 33
  wood-masoni 7
Thalassometrida 61, 62, 64
Thalassometridae 14, 15, 31, 33, 39, 49, 50, 58, 61, 62, 64, 65, 70 (in key), 74 (in key), 75, 76, 498.
Thalassometrinae 33, 65, 71 (in key), 74 (in key)
Thalassometroida 28
Thaumatocrinidae 5, 15, 48
Thaumatocrinus 1, 2, 5, 13, 14, 15, 19, 57, 61, 63, 64, 120, 284

Page
Thaumatocrinus renovatus 50
Thaumatometra 12, 14, 15, 20, 27, 39, 58
Thaumatometra abyssorum 12
  alcyon 51
  alternata 12, 17, 21
  comaster 12, 13, 15
  exigua 12
  hirsuta 12
  isis 12
  laevis 12
  longipinna 12
  nutrix 59
  parva 12, 13, 15, 21
  parvula 12
  remota 12
  tenuis 20
  thysbe 51
thetidis, Austrometra 59
  Oligometra 57
thetis, Antedon 4
  Calometra 8
Thiolliericrinidae 15
Thiolliericrinids 53
Thiolliericrinus 5, 53, 54
Thysanometra 6, 14, 15, 26, 39, 58, 215
Thysanometra tenelloides 6, 14, 21
Thysanometrinae 39, 58, 63, 65
thysbe, Thaumatometra 51
tigrina, Antedon 4
tigrina, Cyllometra 7, 21, 31
timorensis, Alecto 41, 80, 603, 609, 627, 630, 639, 676, 677, 681, 683
  Comanthus 159, 406, 407, 408, 451, 483, 484, 503, 528, 602, 603, 637, 641, 642, 643, 656, 662, 663, 664, 665, 666, 674, 675, 677, 678, 679, 680, 681, 682, 683, 693, 694; pl. 64, fig. 181; pl. 75, fig. 204; pl. 76, fig. 205; pl. 77, figs. 206, 207.
  Comatula 79, 592, 603, 627
  Glyptometra 50
  Metacrinus murrayi 25
Tonrometra 58
Torynocrinus 43
Toxometra 44, 58
Toxometra aequipinna 59
  paupera 44
  purpurea 51
trachigaster, Actinometra 634
trachygaster, Actinometra 41, 79, 593, 601, 602, 628, 679, 681
  Actrinometra 593

Page
Trichometra 12, 14, 15, 39, 58
Trichometra aspera 12, 13, 15
  brevipes 51
  delicata 47, 51
  explicata 30, 58
  hibernica 52, 58
  obscura 38
  plana 52
  vexator 12, 13, 15
trichopoda, Ptilometra 30, 39
trichoptera, Actinometra 565, 570, 571, 575, 580, 585
  Alecto 80
  Comanthus 87, 108, 468, 529, 531 (in key), 553, 561, 572, 579, 586, 588, 589, 591, 592, 682; pl. 3, fig. 4; pl. 74, fig. 203.
  Comanthus (Bennettia) 48, 565, 580, 586
  Comanthus (Cenolia) 50, 580
    (Comanthus) 580
  Comaster 11, 80, 580
  Comatula 79, 579, 585
  Phanogenia 24, 580
trichoptera benhami, Comanthus 57, 587
tridistichata, Actinometra 431, 433
Trigonocrinus 54
triqueta, Antedon 691
  Comatula 691
Triscaedecacnemos 173
triserialis, Zenometra 15, 58
Tropiometra 5, 6, 14, 15, 20, 26, 28, 49, 56
Tropiometra afra 5, 20, 51, 55
  audouini 52
  braziliensis 5
  carinata 5, 9, 14, 17, 26, 45, 46, 339, 592
  encrinus 46
  indica 52
  macrodiscus 5, 51
  picta 45, 46, 144
Tropiometrida 65, 70 (in key), 76
Tropiometridae 14, 15, 26, 34, 39, 48, 49, 61, 62, 64, 65, 70 (in key), 72 (in key), 75, 76
tuberculata, Himerometra 7
  Mariametra 50
  Stephanometra 32
tuberculatus, Eudiocrinus 3, 19
  Metacrinus superbus 25, 26
  Pentametrocrinus 13, 20, 21
tuberosa, Antedon 34
  Charitometra 8, 27
  Glyptometra 34, 36
tuberosus, Metacrinus 25

Page
typica, Actinometra 415, 427, 428, 430, 433, 467, 482, 493
  Antedon 415
  Comaster 11, 37, 406, 408, 416, 429, 430, 434, 442, 459, 465, 503, 504, 505, 636, 642, 665, 666, 683.
  Phanogenia 24, 30, 36, 414, 426, 428, 429, 483
typica f. minor, Comaster 505
Typica group 2, 80, 408, 418, 427, 428
Uintacrinidae 14, 15, 39
Uintacrinids 53
Uintacrinus 13, 14, 17, 19, 23, 41, 47, 53, 359
Uintacrinus socialis 19
umbellata, Bonasa 42
Umbellularia 35
unicornis, Cenometra 32, 36
  Himerometra 30
valida, Actinometra 41, 604, 613, 628, 629, 664, 679, 682
  Actinometra echinoptera var 280, 378, 381, 382, 383, 398
  Aglaometra 55
  Antedon 34, 36
  Comanthus 605
  Comanthus (Comanthus) 604, 629, 681
  Comaster 11, 604
  Phanogenia 24, 604
  Thalassometra 7
Valida group 81, 408, 601, 628, 629, 678, 681
valida-meridionalis, Actinometra echinoptera var 379, 381, 400
Vania 49, 603
Vania annulata 606
  parvicirra 637
vaniipinna, Comanthus parvicirra f 60, 650, 651, 684
  Comanthus (Vania) parvicirra f 684
vanipiuna, Comanthus parvicirra f 636, 664, 665
variabilis, Actinometra 36, 415, 421, 427, 428, 429, 634, 682
  Comaster 11, 416
  Phanogenia 24, 416
varians, Eudiocrinus 3, 19
  Metacrinus 25
  Pentametrocrinus 13, 21
variegatus, Eudiocrinus 13, 19, 20
variipinna, Amphimetra 32
  Himerometra 7, 31
venusta, Pterometra 50
venustulus, Eudiocrinus 49

Page
venustus, Leptonemaster 37, 64, 130, 135, 231, 235, 269, **276**, 295, 388, 396, 398, 399; pl. 22, figs. 59–61.
vepretum, Colobometra 41
vera, Crotalometra 50
Vermiformes 40
verrilli, Rhizocrinus 14, 38
versicolor, Antedon 4, 52
  Calometra 8, 21
vexator, Trichometra 12, 13, 15
vicaria, Antedon 23
villosa, Antedon 4, 7
  Thalassometra 7, 27, 33
viridis, Selenemetra 44
virilis, Notocrinus 59
vivipara, Isometra 59
wahlberghii, Actinometra 589
wahlbergi, Actinometra 589
  Comauthus 589
  Comatula 589
wahlbergii, Actinometra 589
  Alecto 41, 79, 80, 588, 592, 677, 678, 681, 682
  Comanthus 46, 213, 529, 531 (in key), 581, 584, 585, **588**, 592, 677; pl. 65, fig. 183.
  Comanthus (Bennettia) 45, 589, 681
  Comanthus (Cenolia) 589
  Comatula (Actinometra) 589
weberi, Comantheria 49, 484 (in key), **505**, 507, 508; pl. 58, fig. 166
  Comanthus 505
  Rhizocrinus 38
wilsoni, Antedon 48, 49

Page
wilsoni, Nanometra 5
wireni, Psathyrometra 59
wood-masoni, Thalassometra 7
woodmasoni, Bathycrinus 38
  Cosmiometra 34
wyville-thomsoni, Endoxocrinus 16, 23, 26
  Pentacrinus 60
wyvillethomsoni, Endoxocrinus 45
  Pentacrinus 10
wyvillii, Metacrinus 23, 25, 36, 60
xantha, Comanthus annulata var 606
xanthum, Comanthus annulatum 606
  Comanthus annulatum var 606, 615, 630, 631
Zenometra 6, 14, 15, 39, 58
Zenometra columnaris 6
  pyramidalis 15
  triserialis 15, 58
Zenometrinae 39, 57, 58, 61, 63, 65, 284
zonatus, Metacrinus 30
Zygometra 5, 13, 14, 15, 19
Zygometra andromeda 50
  comata 49
  elegans 5, 31, 37, 48, 49, 55
  fluctuans 49
  hartlaubi 5, 19, 20
  koehleri 5, 19
  microdiscus 5, 37, 48
  multiradiata 5
  pristina 44
  punctata 49
  rubroflava 5, 19
Zygometridae 13, 14, 15, 19, 21, 26, 39, 49, 61, 62, 65, 70 (in key), 72 (in key), 75, 76

○

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